USB Microscope

Preface

I like to be inspired by other projects and I found a lot about USB microscopes at Instructables. I could use one for my own projects and by the way my roommate had an old one lying around. After a short conversation, she sold it to me for a small price. There are many people who think that hardware hackers always need to create something new. This is only partly true, because hackers also learn by recreating projects. I like to learn e.g. by haptic perception. I have to touch everything, turn and so on. When I read through a tutorial I don't have any problems with the content, but it's less fun. And since I like to learn when I have fun doing it, I build things.

In addition, our culture is based on the copying of learned processes, technologies or developments. When we are children we copy our parents, when we get older and as teenagers we have to re-orient ourselves every day and we copy young adults from our circle of friends and that goes on all our lives. Someone has seen that it is worth breaking stones to develop a knife like object. The household knife you use every day to peel your apples is a copy of millions of different knives, all based on the original stone knife. When I copy a USB microscope, it is still an in-house development, because it is based on the mother of all microscopes of the Nimrud lens. Copying something is naturally good, because you don't just show respect for the developer or the idea, you also transport the idea further into the next generation. Good knowledge continues to spread and thus remains a part of humanity. At the age of 8 I was in the Neanderthal Museum and learned how to recognize flints and how to make a stone tool from them in a very slow and difficult process. I carry this knowledge within me and can retrieve it as needed and pass it on to the next generation. You can never be sure when you may need this knowledge.

I also like to optimize ideas. Here you can work a little more with the image quality, at this point you might prefer to use metal instead of plastic. There is no perfect development. What may be incredible these days may seem ridiculous to us in 50 years. Just look at the history of the video game console. Do you remember tapes? I grew up with it. It's all a matter of perspective. To test if the idea works at all I simply held a lens of an old digital camera in front of the webcam and carried out first tests. I examined the circuit board of an e-reader and a flower from my garden. Even if the pictures are still blurry, you can already see many more than with the naked eye.


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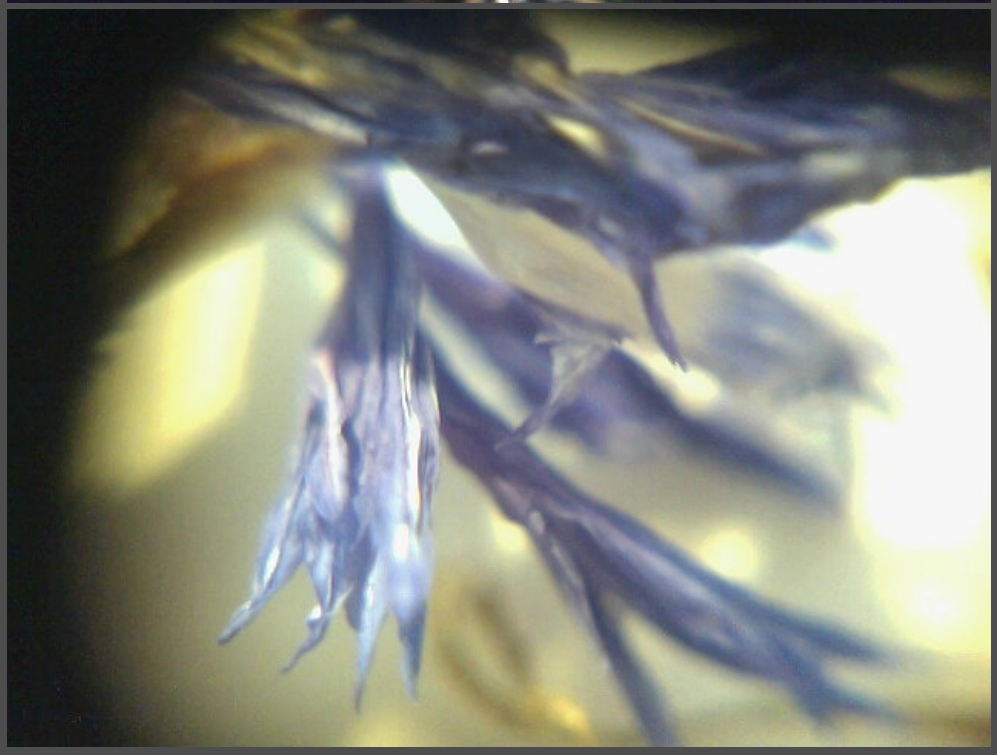
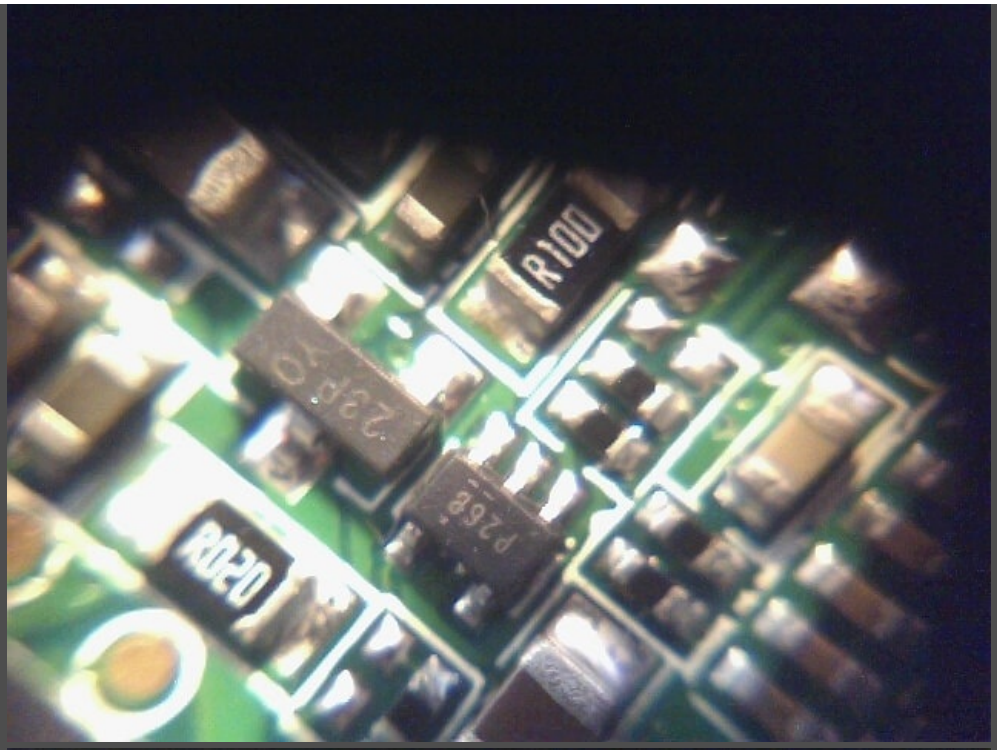
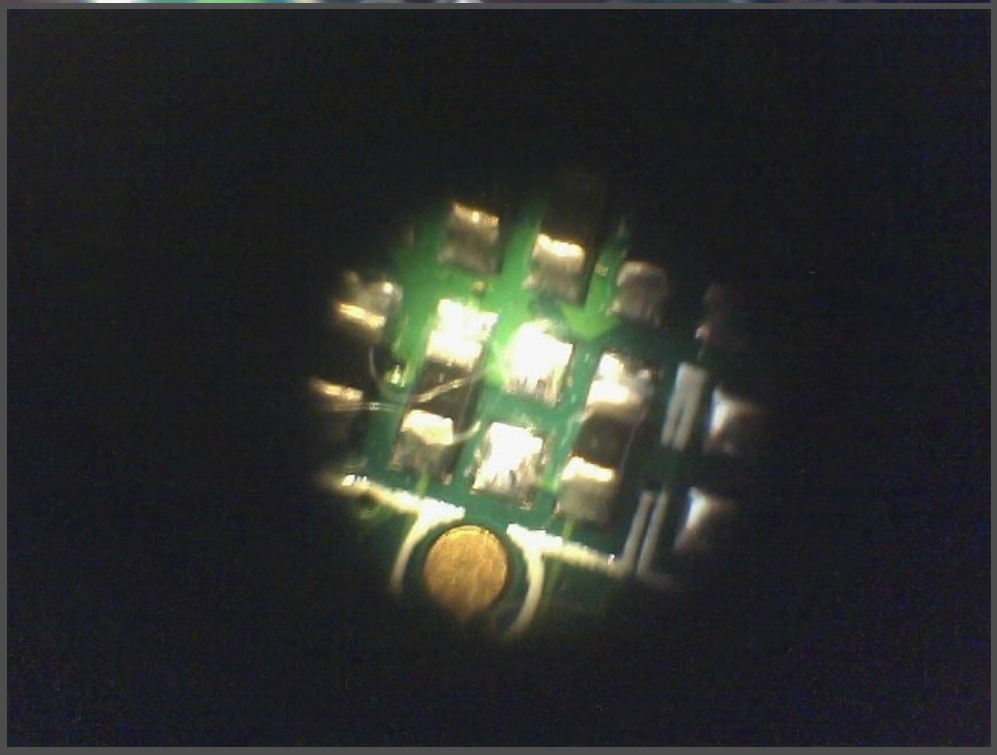


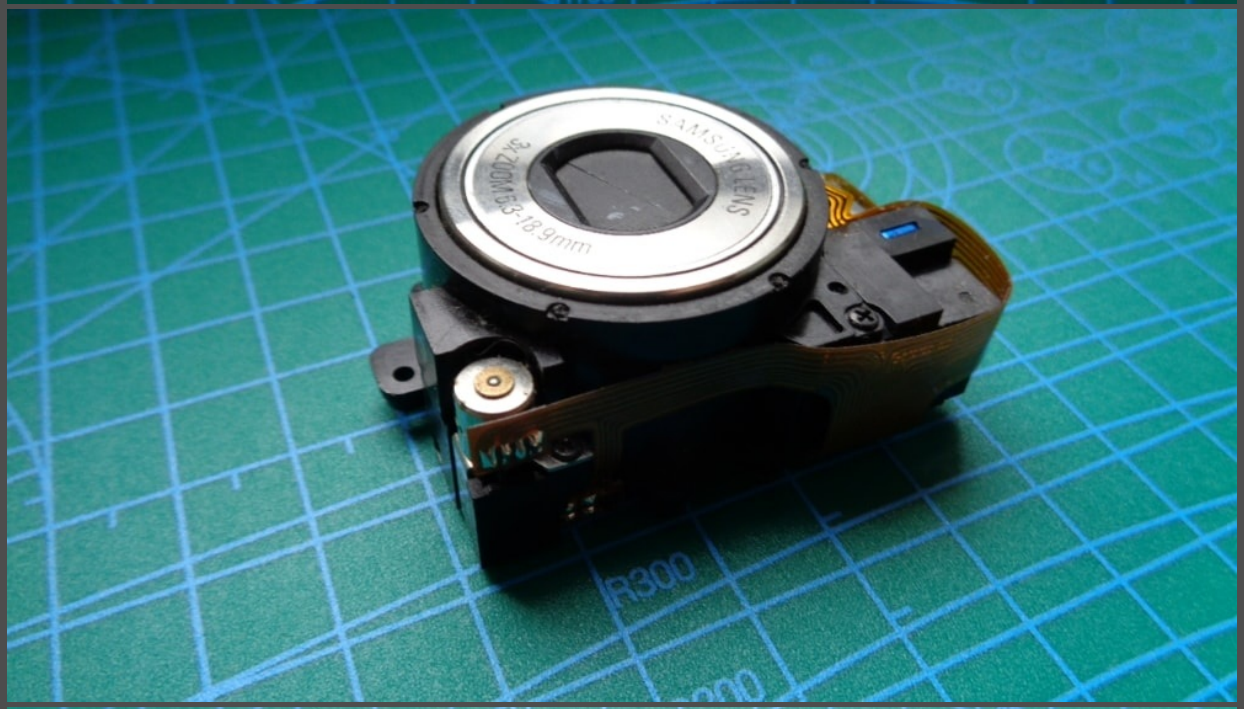




Materials

Our main components consist of the lens of an old digital camera and an old webcam. Otherwise we only need the tools listed below. I advise against breaking a digital camera, but to look in the cellar or ask friends first. Sometimes you can also buy a cheap one at the flea market. The same goes for the webcam, where you can also order a cheap one. Webcams are things that everyone had lying around at home in my time, even though most of them were of questionable quality. You can see this later on the photos below in the final test.


SAMSUNG LENS
3x ZOOM 5.3-18.9mm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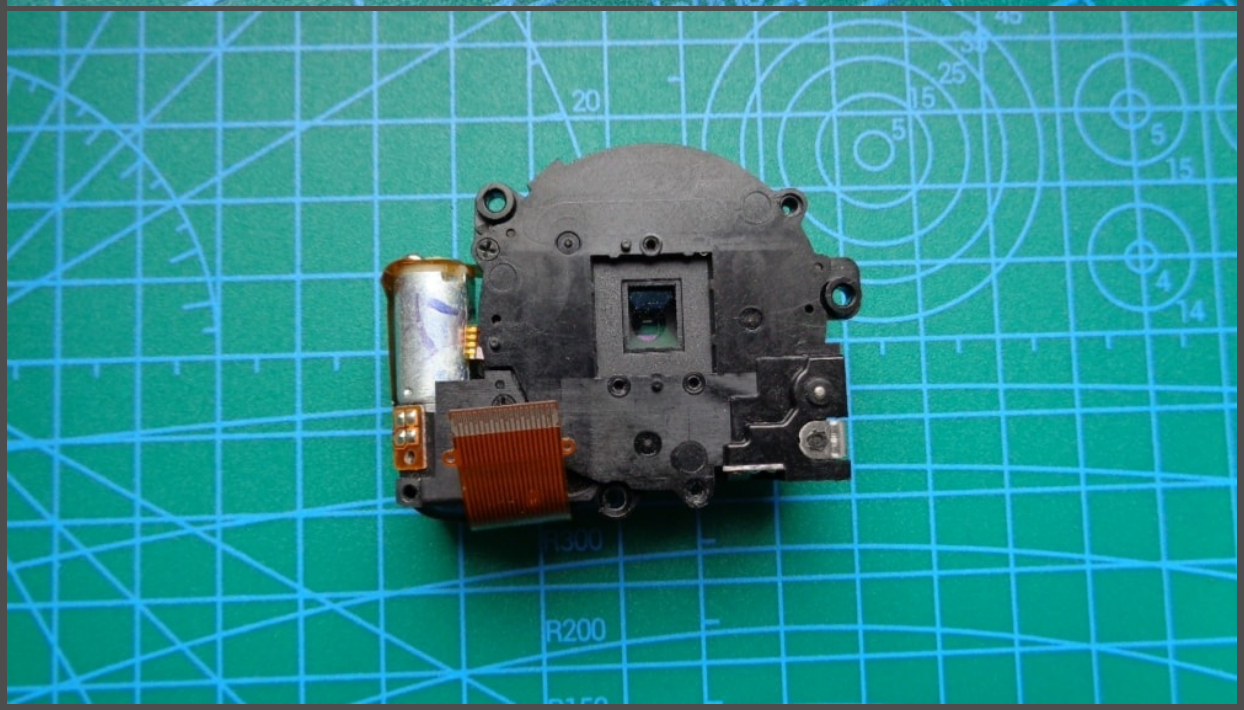
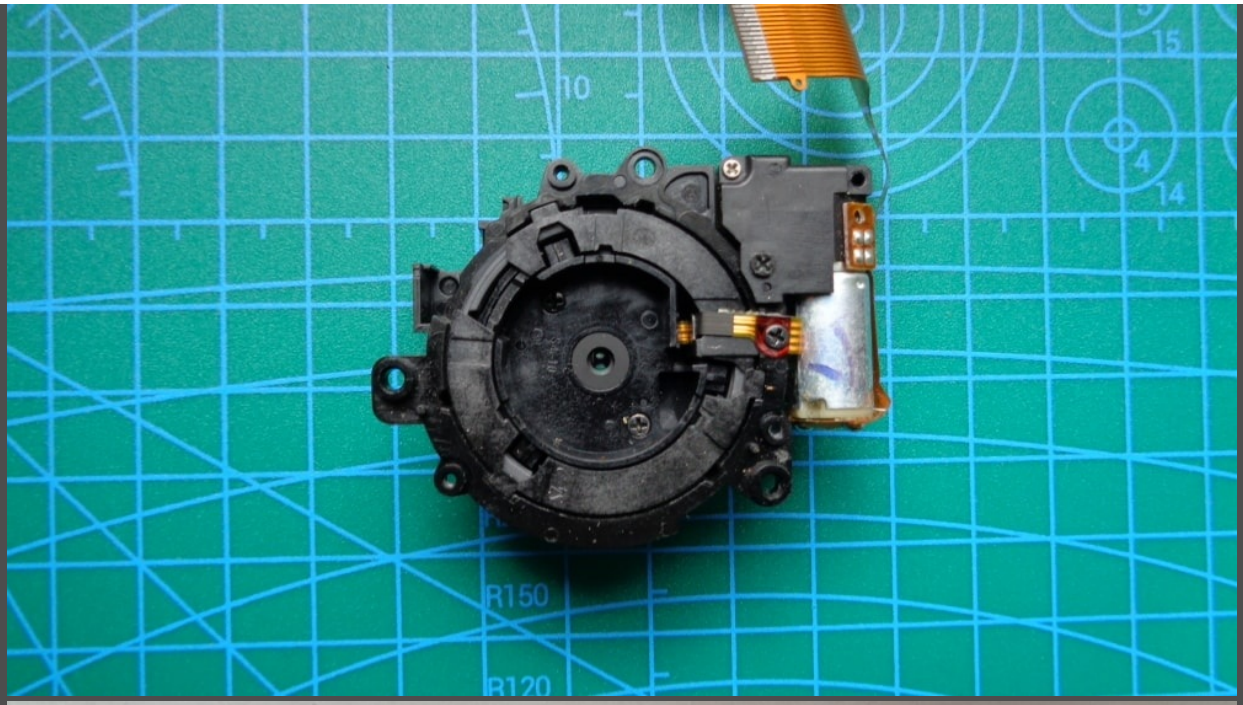
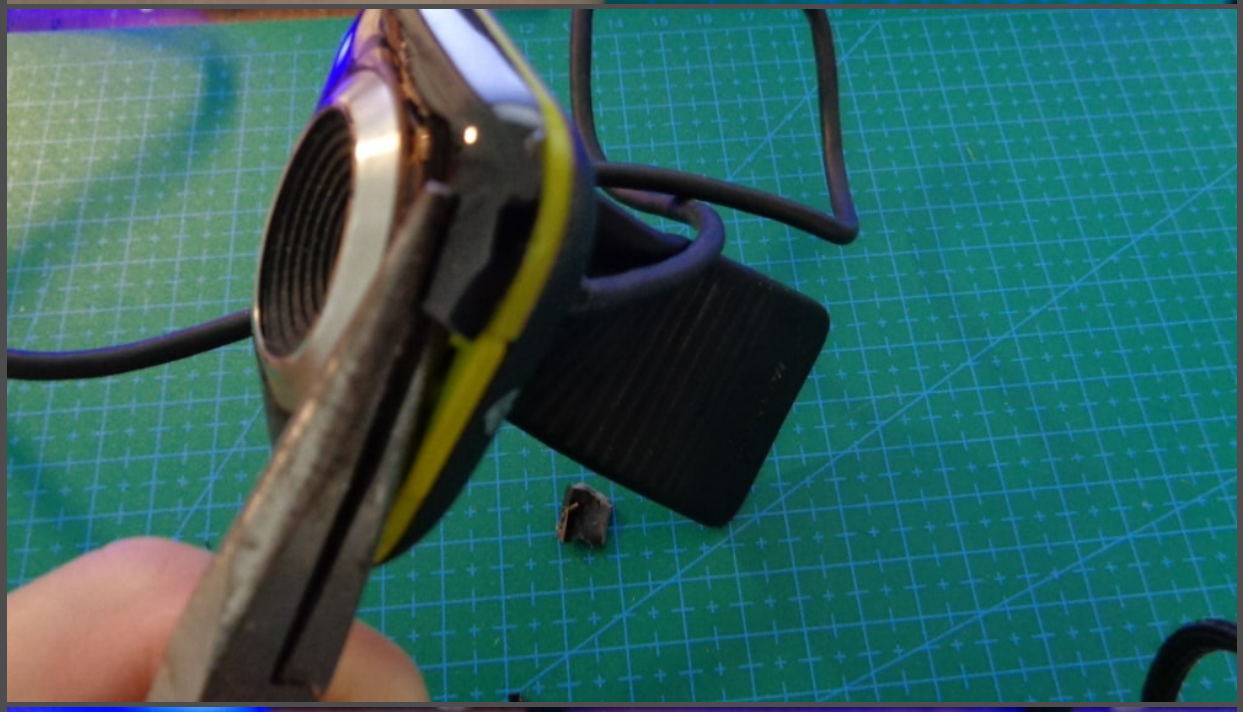




- Old trash Webcam
- Lens of a broken digital camera
- Precision Knife
- Pliers
- Tweezers
- Screwdriver
- Scissors
- Toothpicks
- Glasses cleaning cloth
- Two clamps
- Instant glue
- Empty plastic lemonade/water bottle
- Hacksaw
- Safety googles

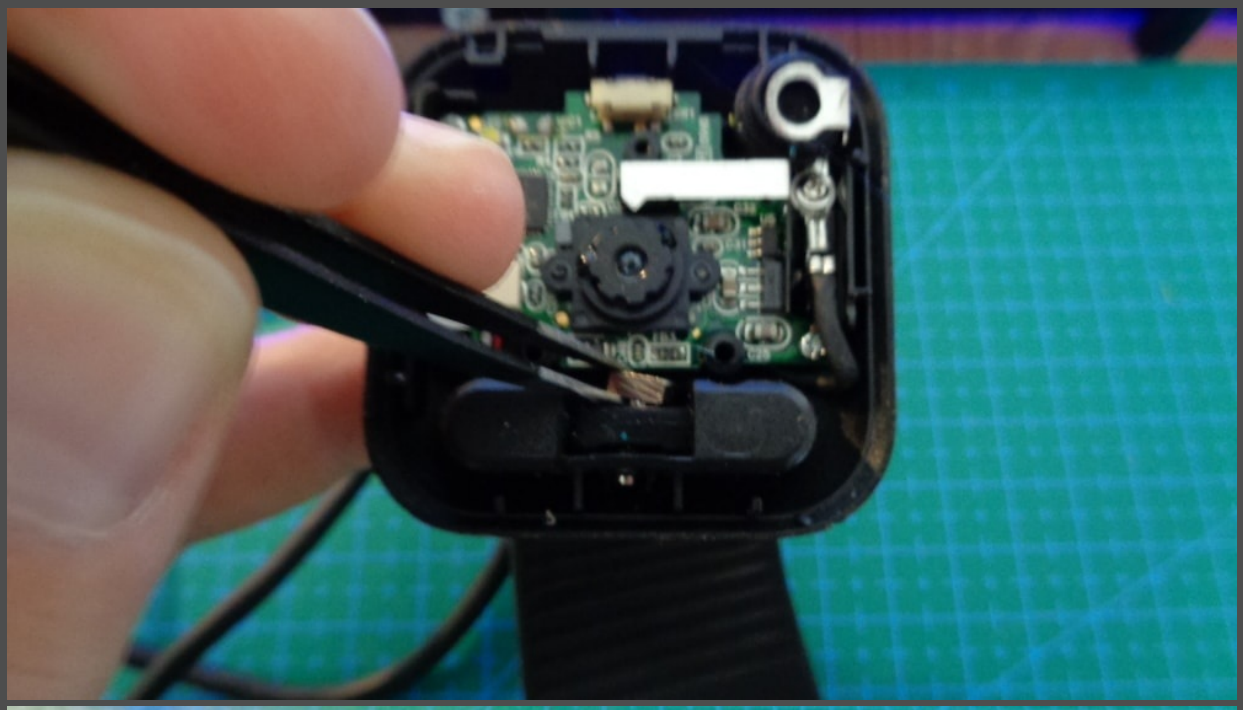
Realisation Part I

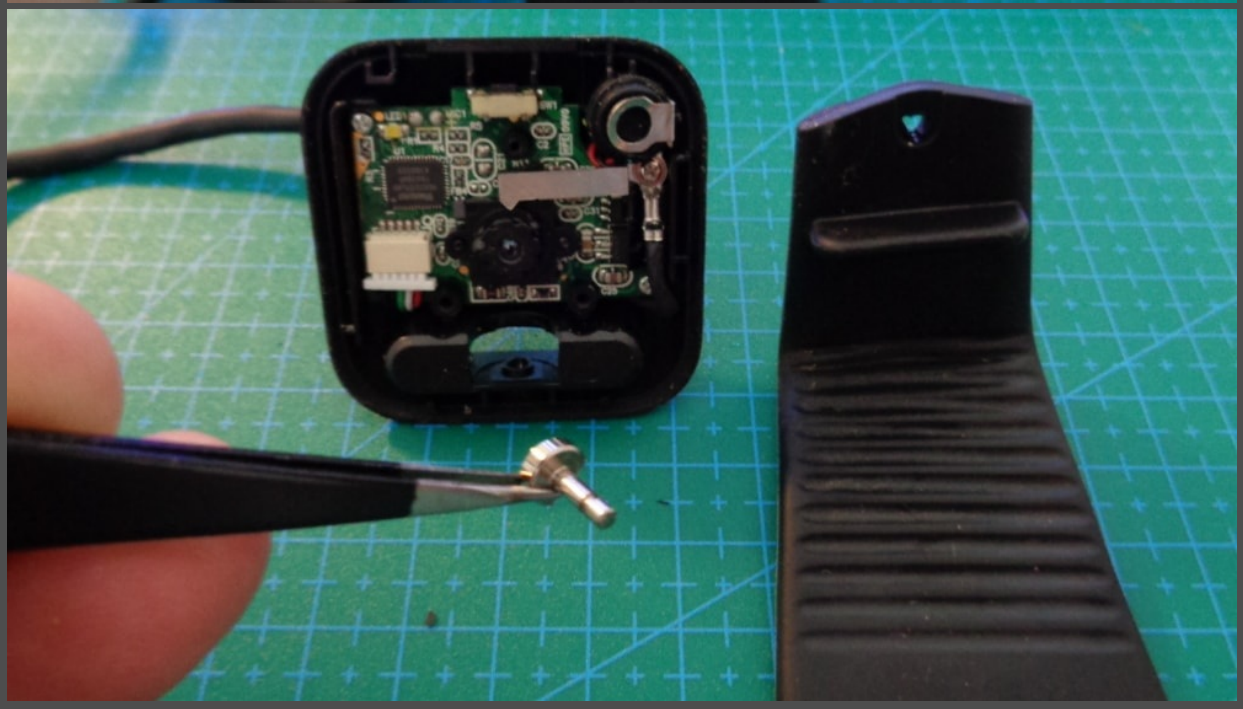
First we have to separate the superfluous housing from the board. This is best done with a carpet knife and pliers. In most cases, the housing should be screwed, which can then be unscrewed with a screwdriver. Only asshole companies headquartered in Redmond, Washington, who don't want to repair webcams themselves, glue them completely during industrial production.



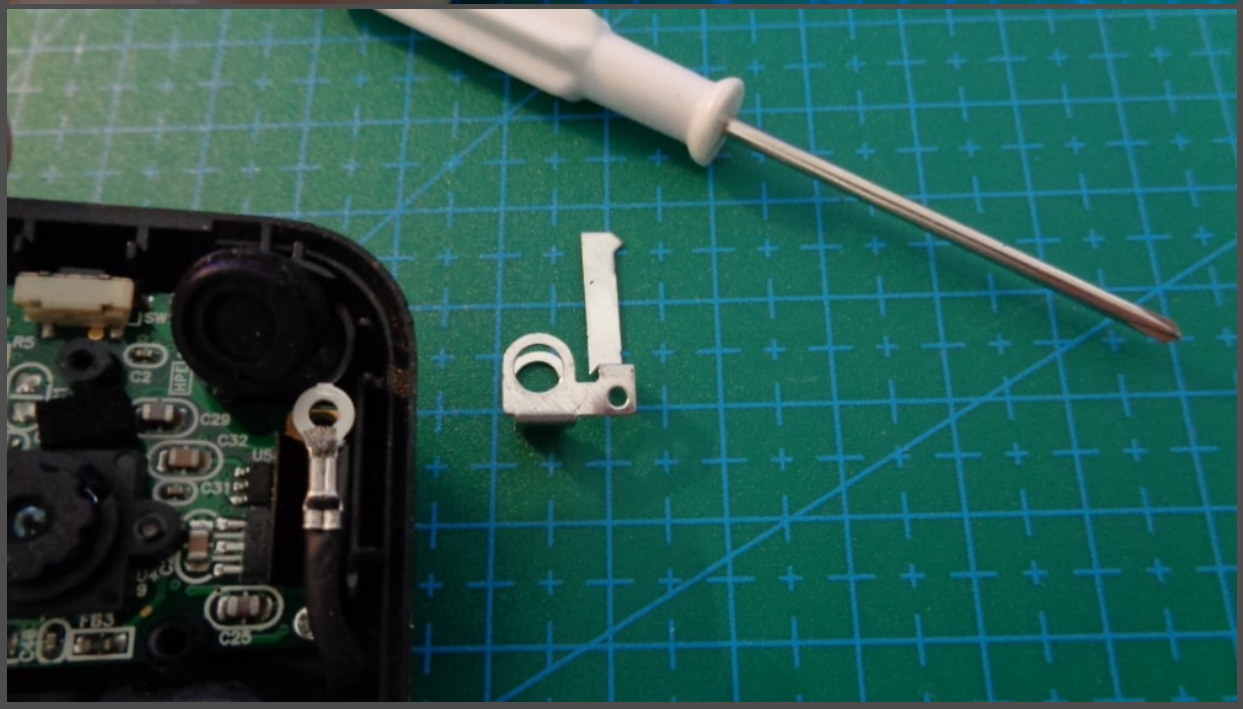
The flexible holder of the webcam is only held inside the housing with a metal pin. We can simply pull it out with tweezers, as it is not glued or screwed. We put the parts aside and pack them into a

box after work, where we store them in a safe place. You can use something like that again and again later and you should get used to throwing as little as possible into the trash can while hacking the hardware. This not only saves money, but also protects the environment.

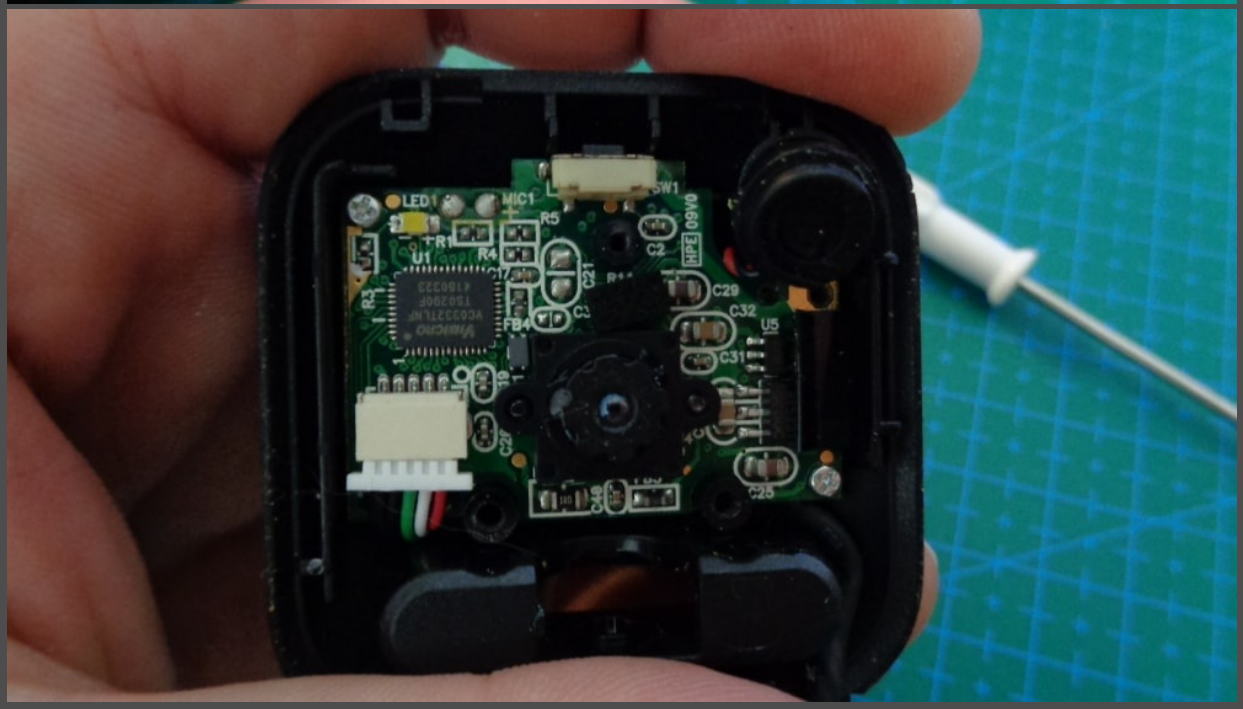




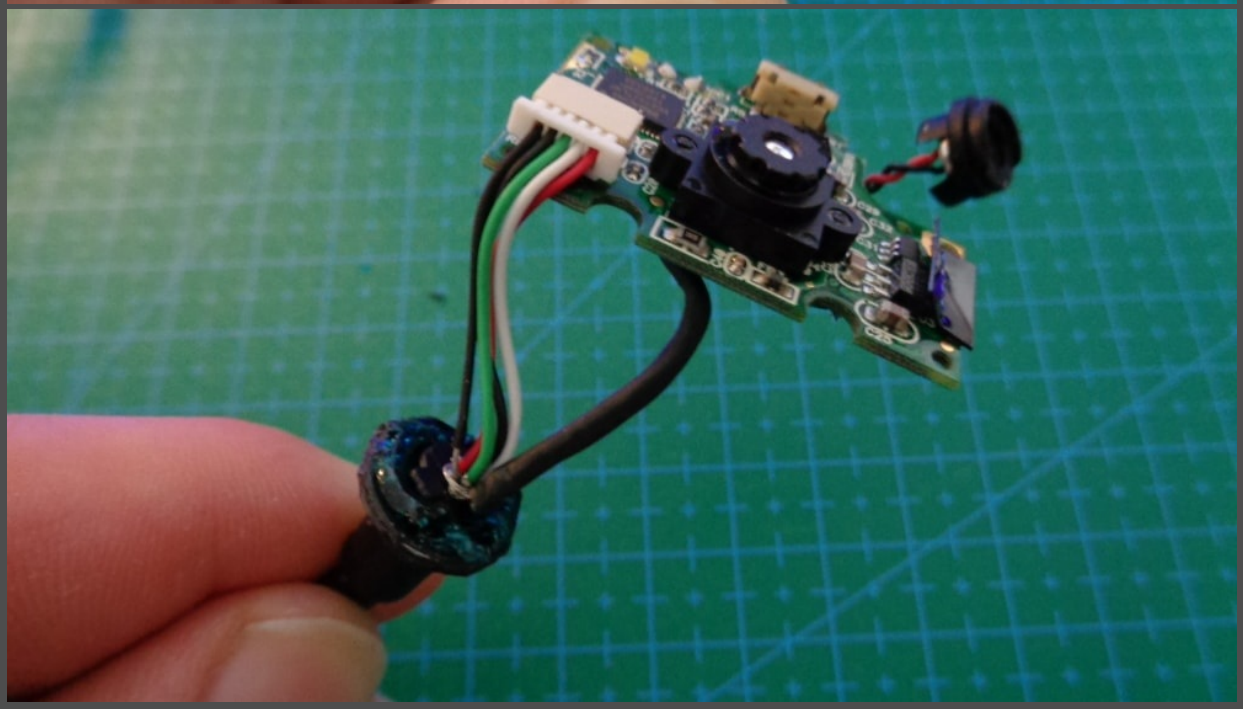
Then we have to loosen the black GND cable with a screwdriver. A small piece of metal falls off, which we also store. With our first prototypes we will not connect this cable anywhere yet, but will implement it in later versions. May the electric gods forgive us.



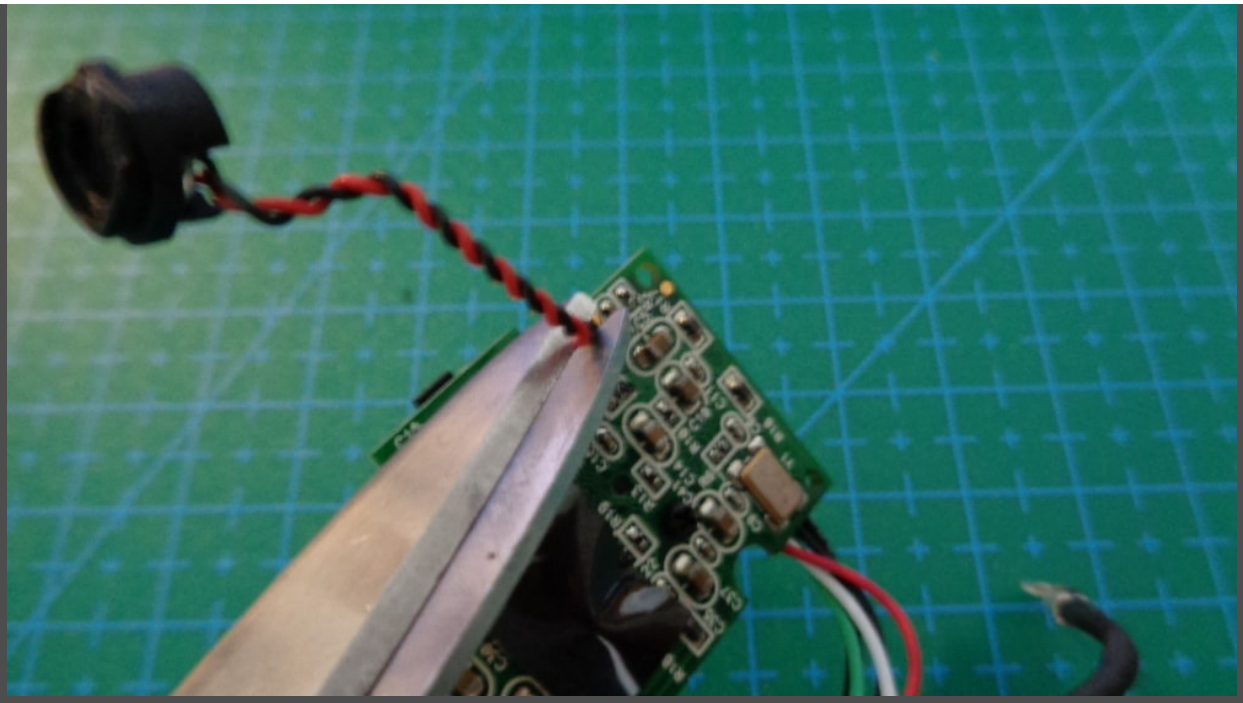
The complete board of the webcam is held by two small screws. One in the upper right and one in the upper left corner. We solve these so that we can continue working.



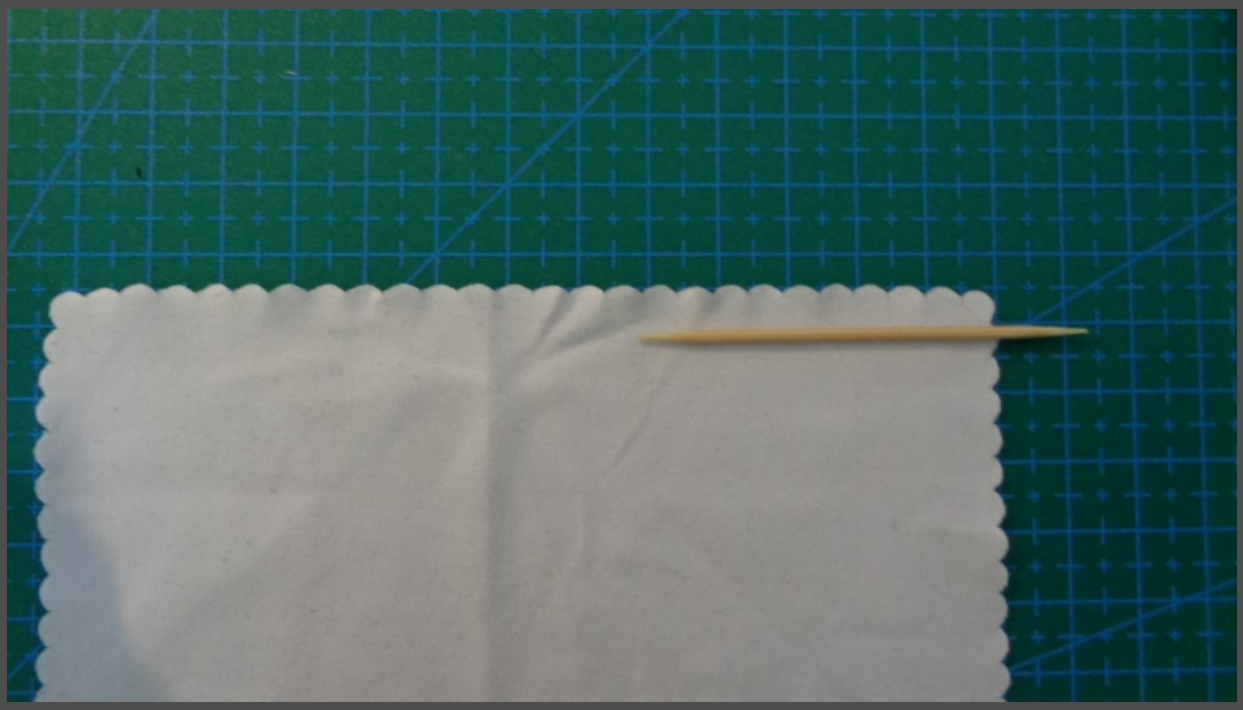
Now we come to a place where we need to be a little more careful. Unfortunately you can't disconnect the cable from the rear housing without breaking one of them. It would be possible to solder the cable again, but it costs additional work that we want to save. Therefore we cut the rear housing with scissors, sharp pliers. Since the connecting piece of the cable is also glued to the plastic we cut cleanly along the edge.

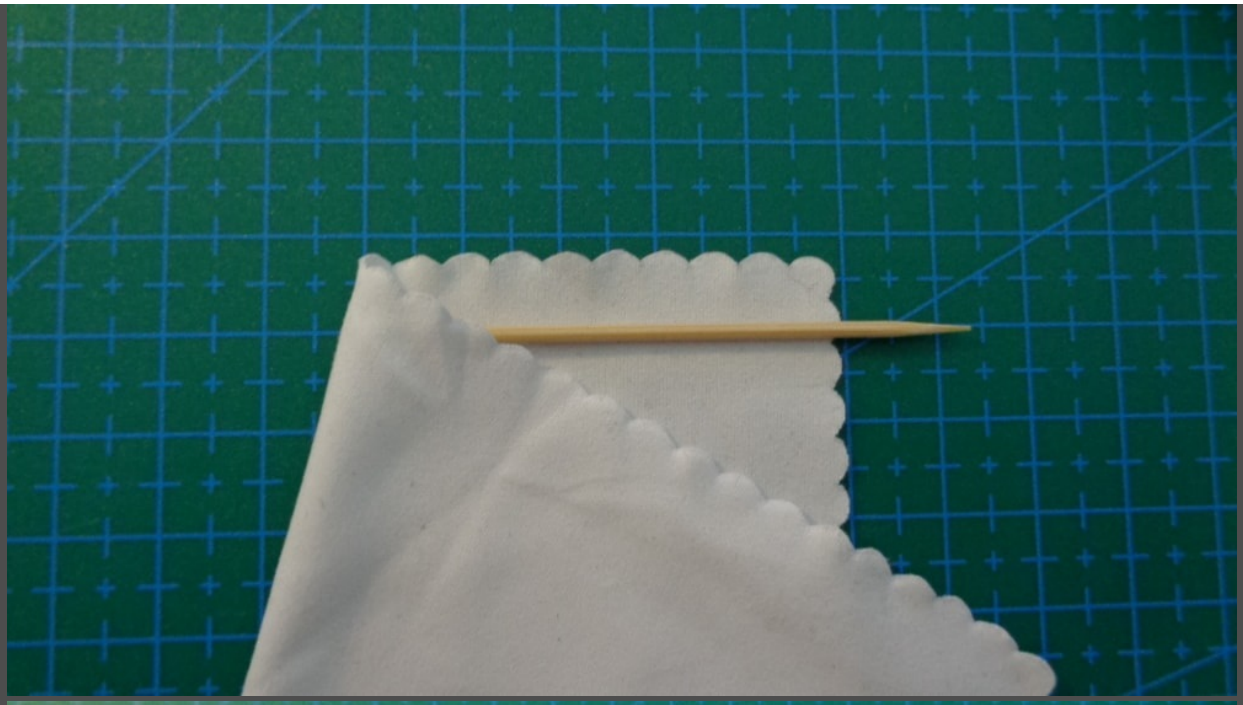


In the first version of our USB microscopes we don't need a microphone yet, so we separate it from the board with scissors. If we want to solder on a (better) microphone later on, this is no problem, because the solder points are not damaged.



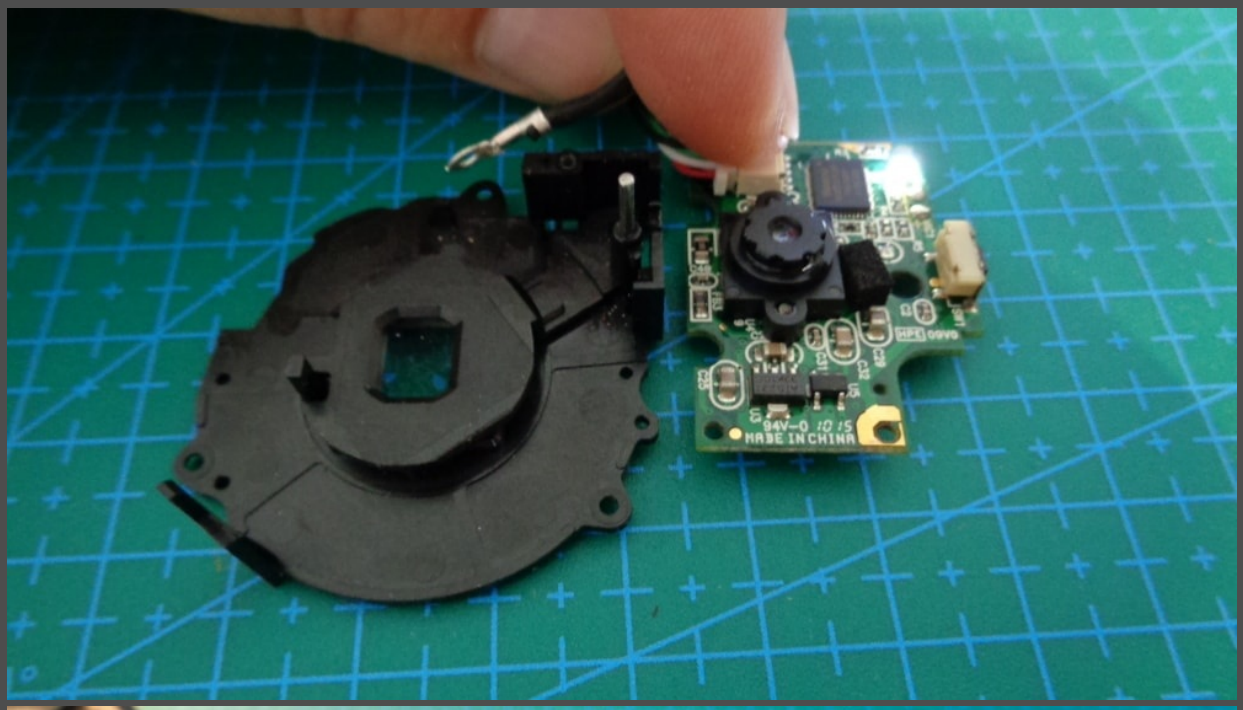
Since we should clean the lenses before we stick everything together, we have to fold a toothpick into a glasses cleaning cloth as we see on the photos below. With our fingers we would not reach the small lens and the toothpick helps us to clean the corners properly. This is how we improve the quality of our photos right from the start.

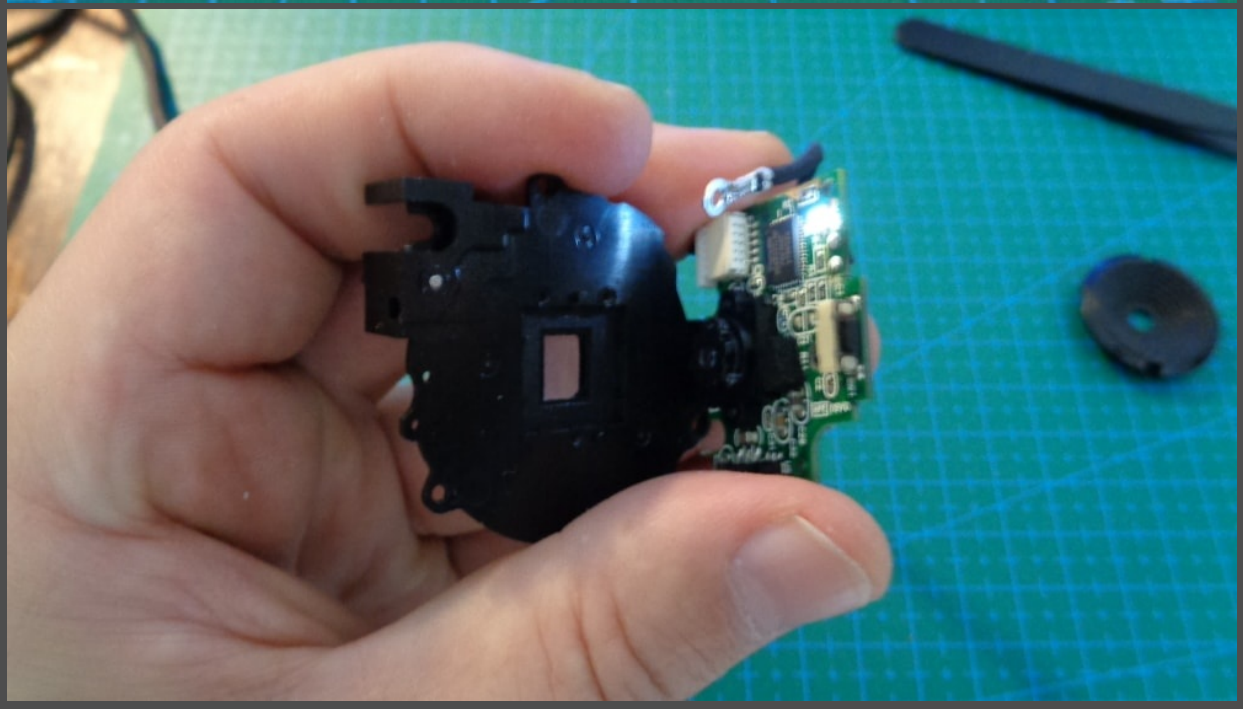


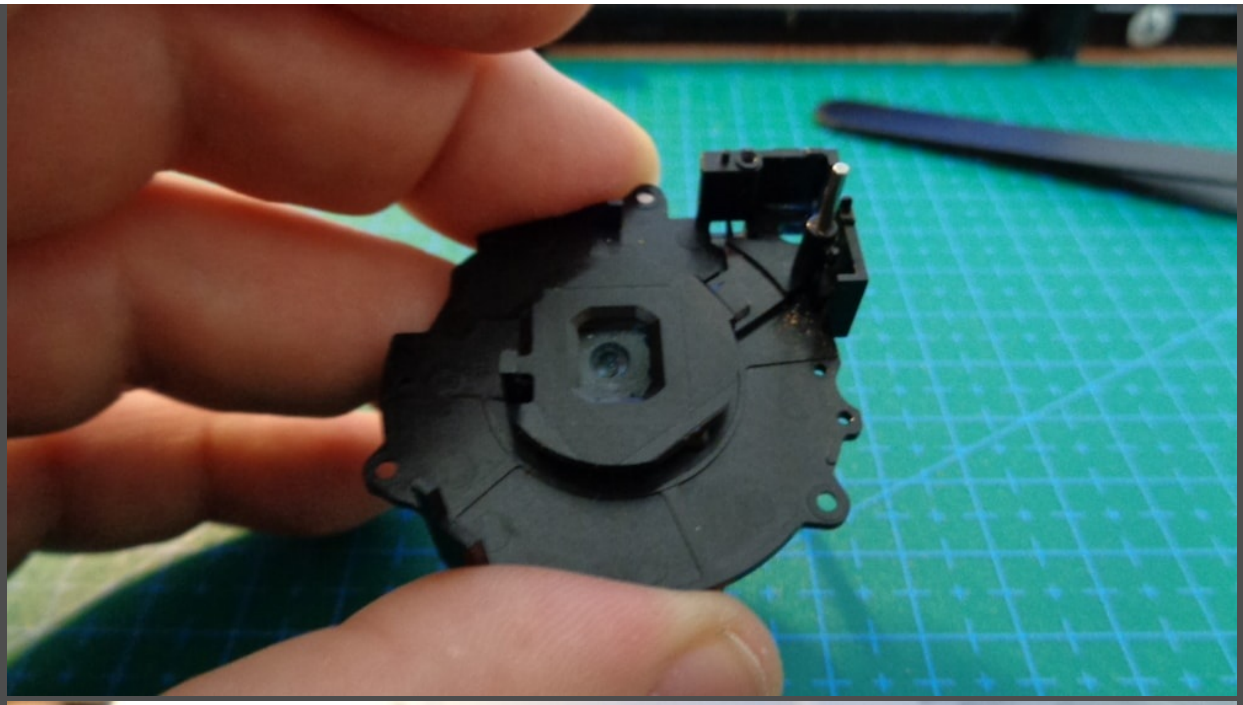


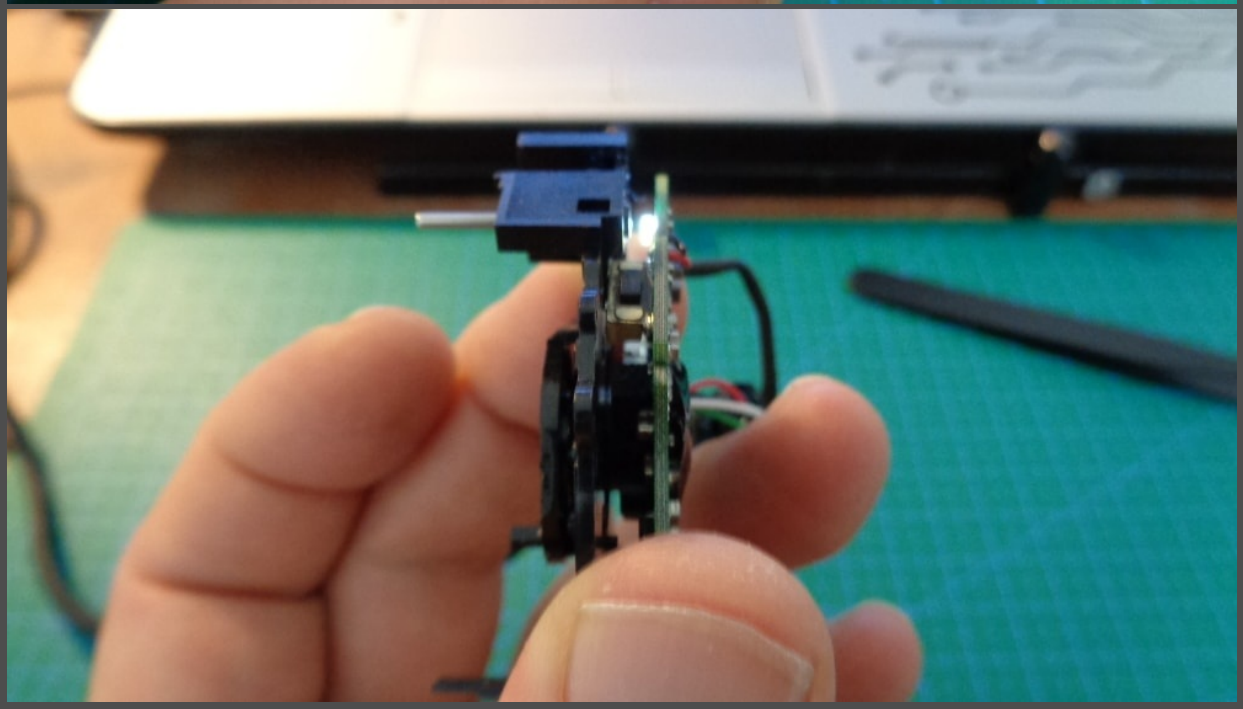
It's time to glue our lens (with a second lens from the digital camera) to our board. I put the superglue in the place with a toothpick where the button for triggering the camera is located. I

don't need it anyway, because I create the photos with the Cheese software. The button should not be visible later anyway. If you want to do this differently, you don't have to stick to my guidelines, of course, but develop your own idea of how you want to solve the problem.





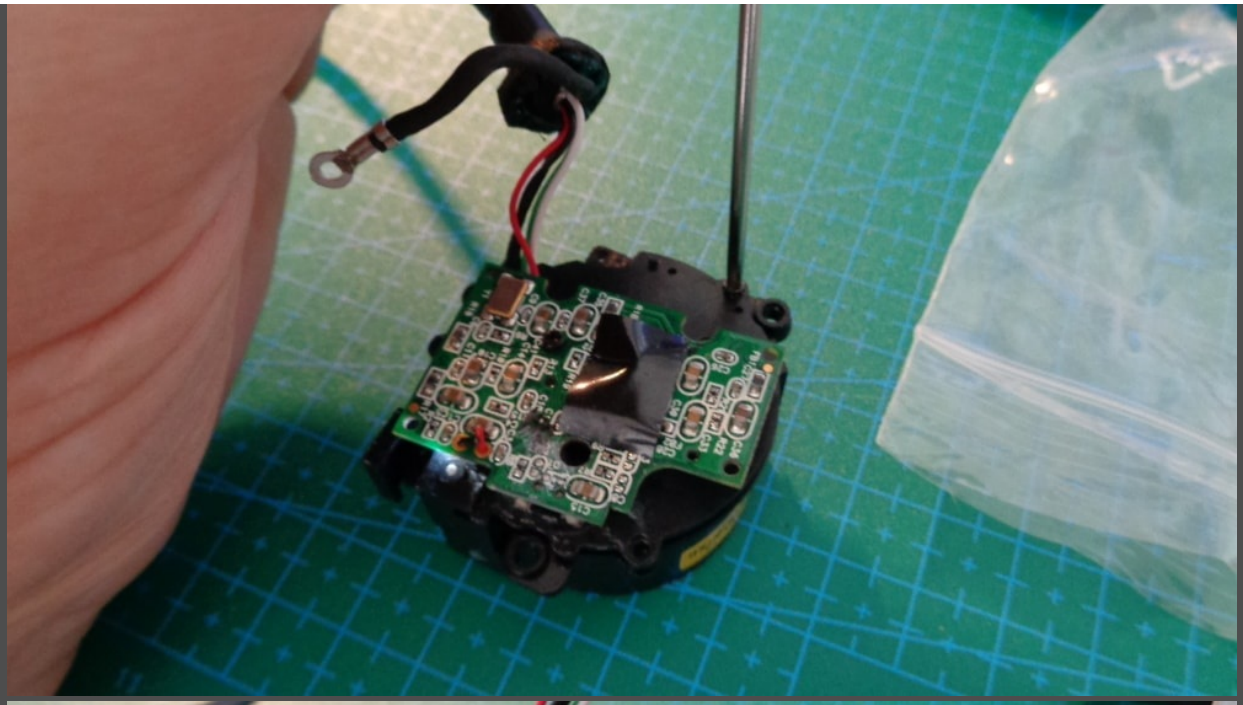


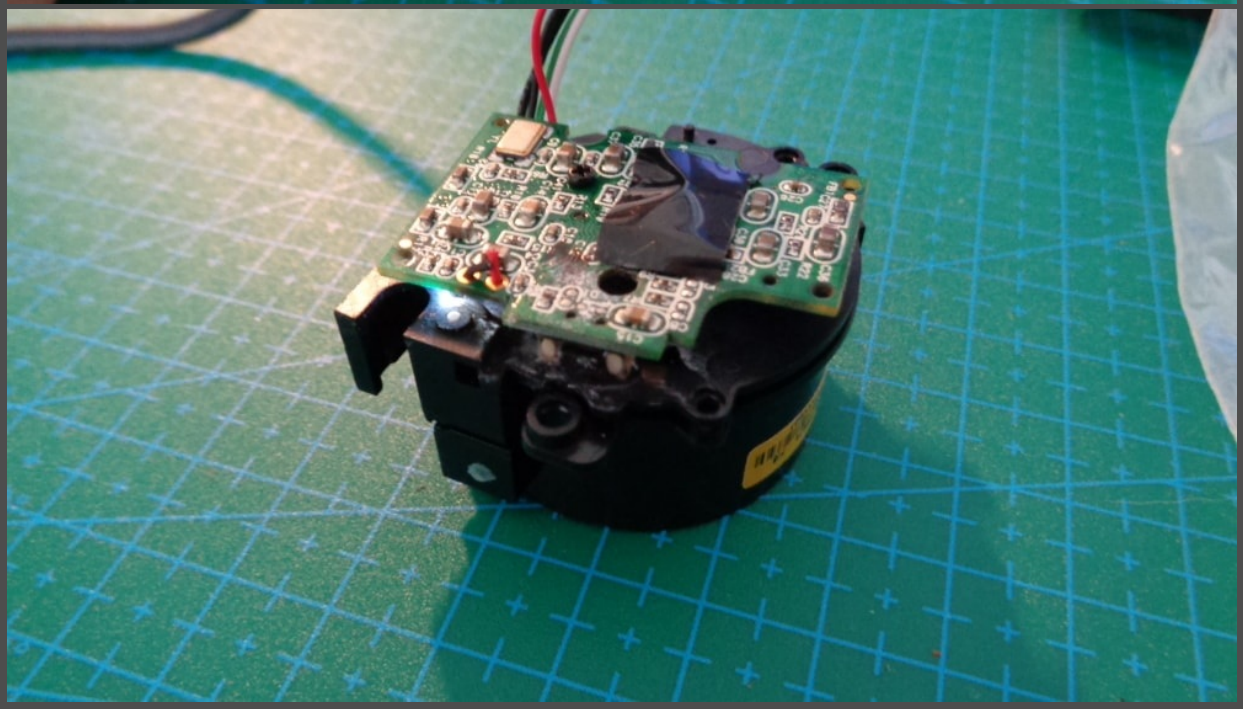


I have often read in forums that people towering over it quickly clog up the tubes of cheap superglue. I have a few things to say about that. After this tutorial I will use superglue only in case of emergency, because it attacks and destroys the plastic very strongly. If I have a blocked tube, I simply unscrew the lid and insert a toothpick. Then I take out a tropical glue and apply it to the area that is to be glued. It is therefore not necessary to buy a new tube immediately.

With a plastic clamp the parts are held together as long as they dry. Please do not use metal clamps, as this can damage the board. The clips can be bought in any supermarket and are not expensive and only cost a few euro cents.

After everything has dried thoroughly for at least one hour, our construction is screwed onto another component from our old digital camera. We kept the screws as a precaution and can use them again now.

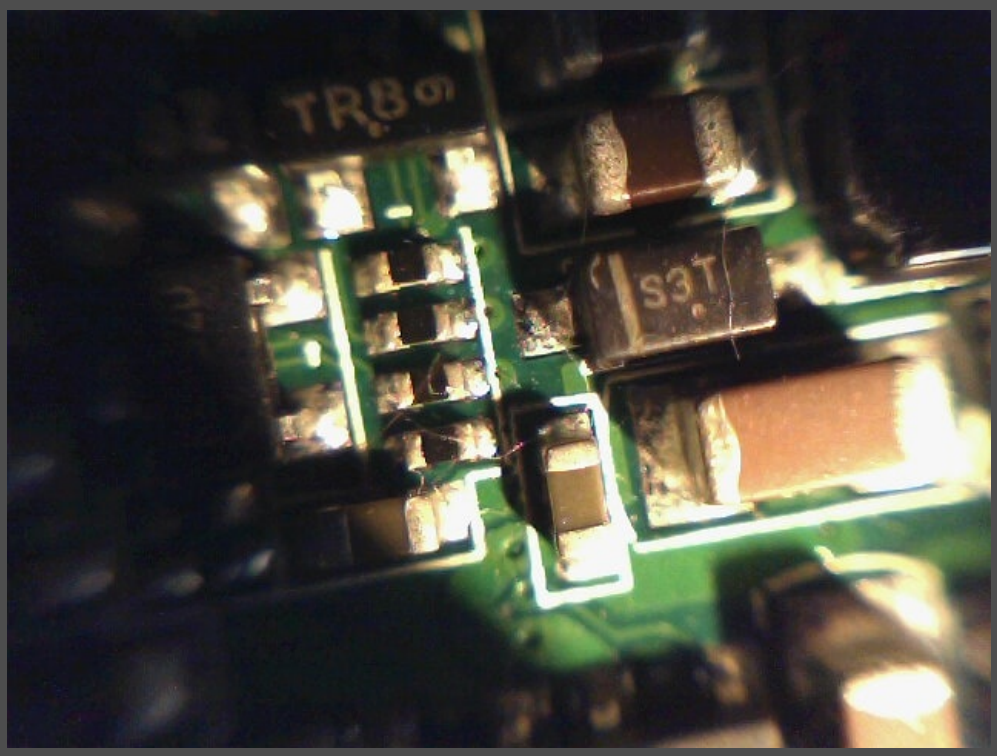


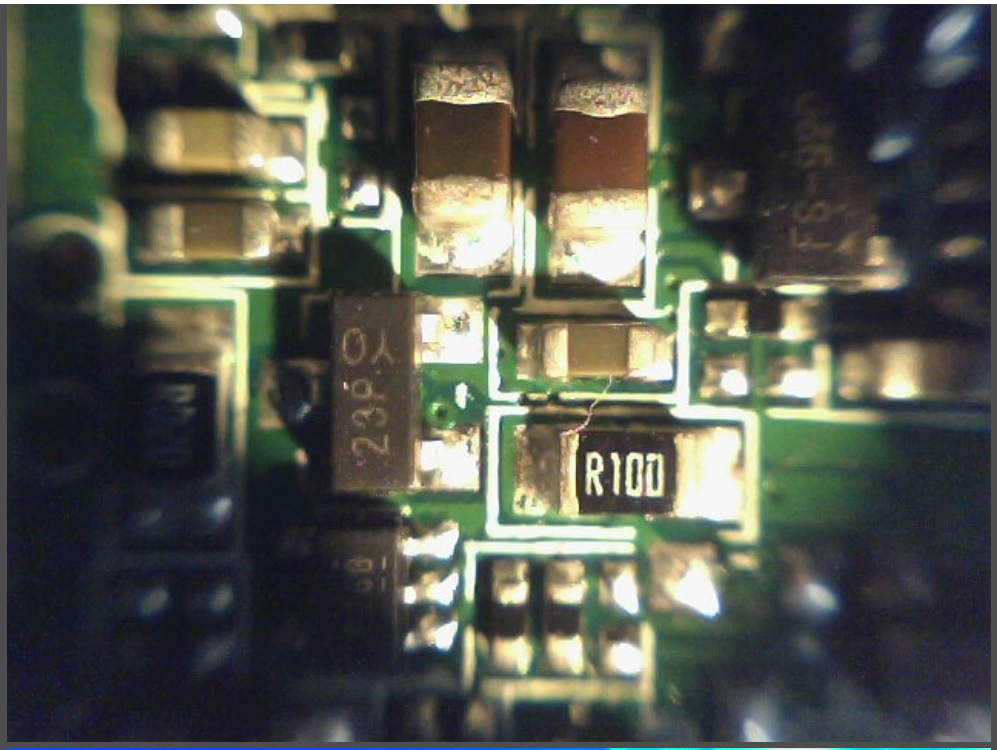


Now we can already do the first test. For this purpose I took the circuit boards from my e-reader project as an object of investigation. Of course, everything is possible. In my opinion, PCBs are the most suitable because they have many details that can be examined. You can also take something from the garden, e.g. small stones or something. What you can't so easily see with the naked eye.

USB microscope test I

The first test went quite well, but I was not satisfied. I could improve the image quality of the lenses, but I didn't take into account that they also need external light. With a webcam that depicts a person, it doesn't matter, because there is enough external light. But if you now seal a lens with an (almost) light-tight plastic ring, you can see very little. I had then tried to light it with a blue LED, but quickly realized that this light source is much too bright for such a simple camera. Nevertheless you could see something on a big monitor and that's the basic idea of the project. I want to display small things in big.

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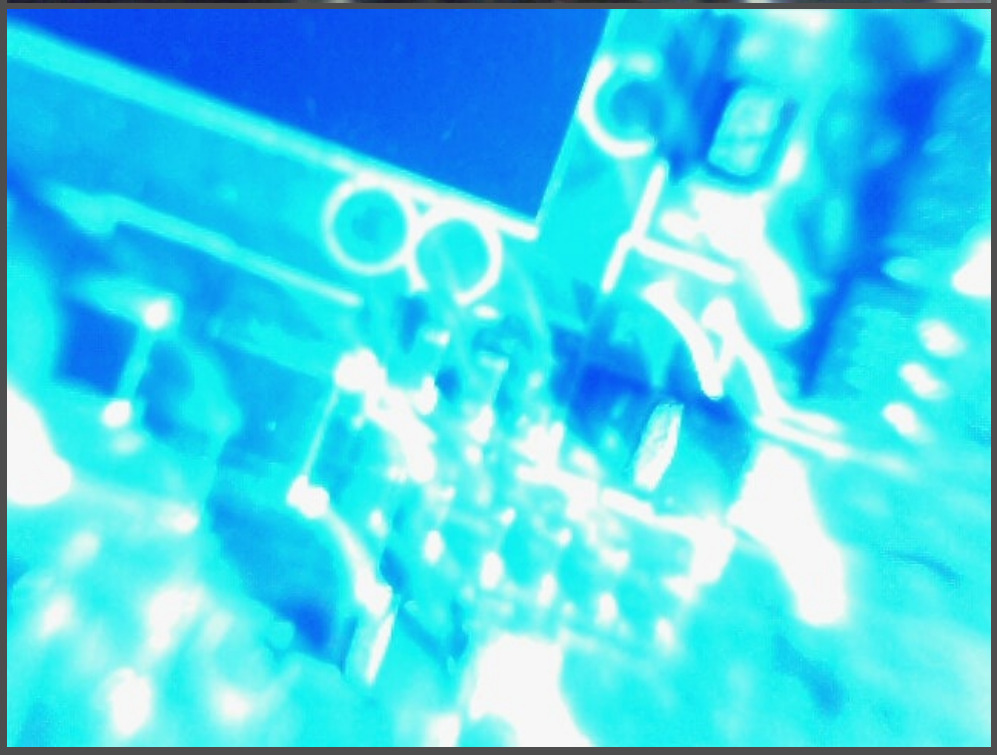
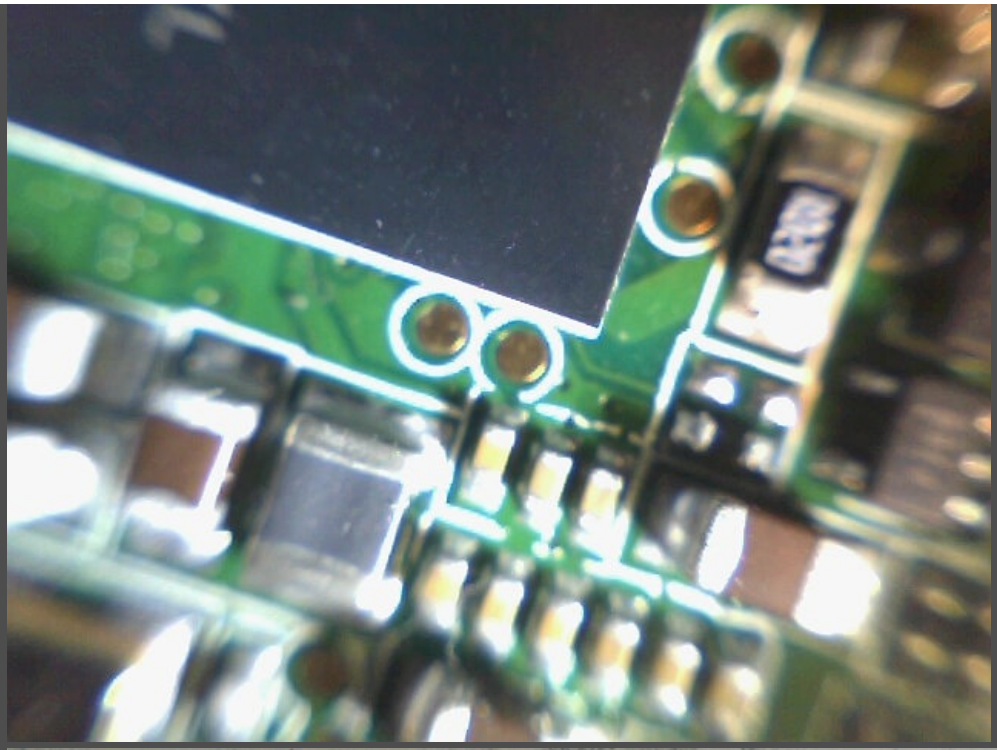
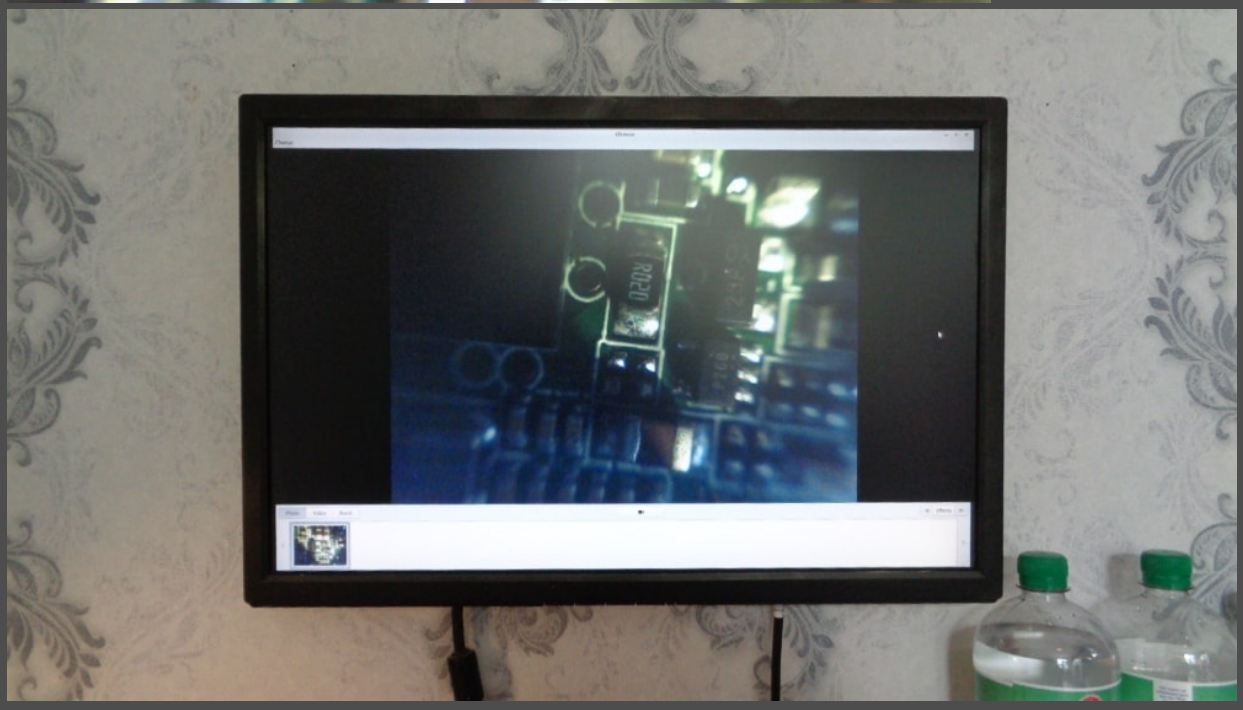






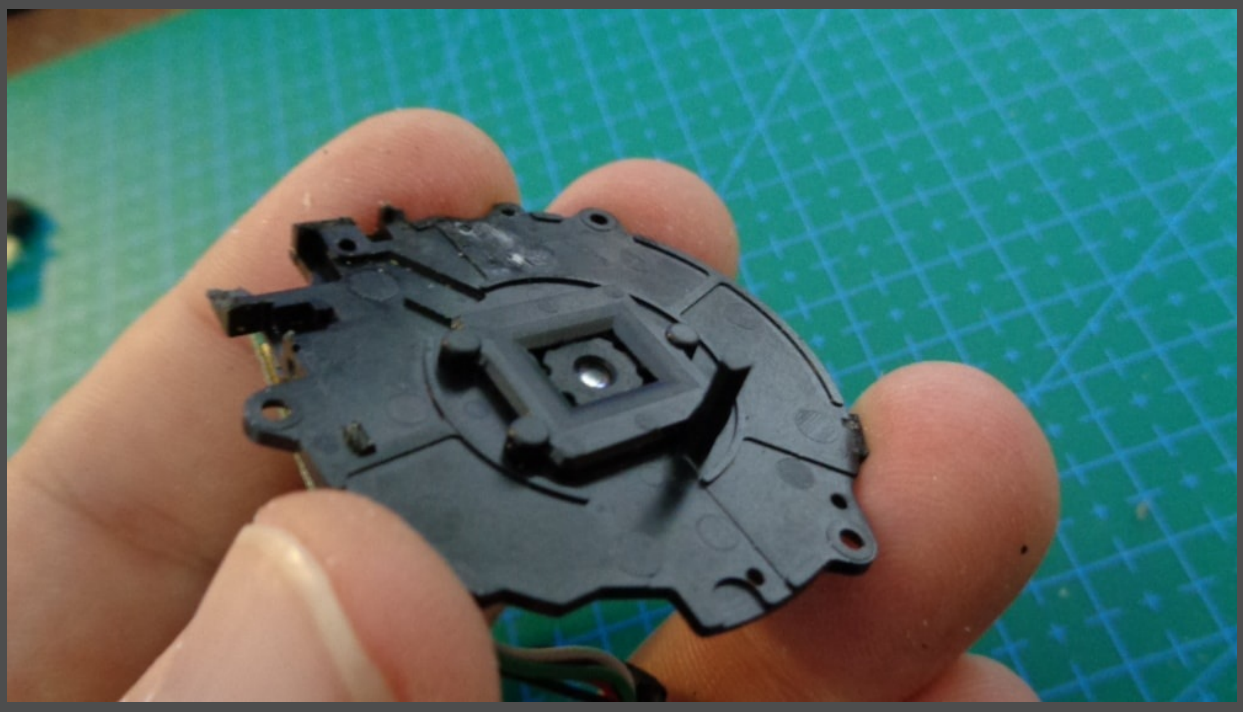
Realisation Part II

To solve the problem with the missing light I had to remove the black plastic ring from the previous construction and look for something else. I took my time and thought about it for three days until I had a sensible idea. Couldn't you just use the neck of a bottle of lemonade as a ring? The transparent plastic could allow enough light to penetrate the microscope and significantly improve the image quality. Of course I couldn't use the microscope at night, but that's a secondary problem you can deal with in another version at the moment. I measured the width of the ring and bought a matching iced tea bottle in the supermarket. I also realized that I don't like cheap iced tea.

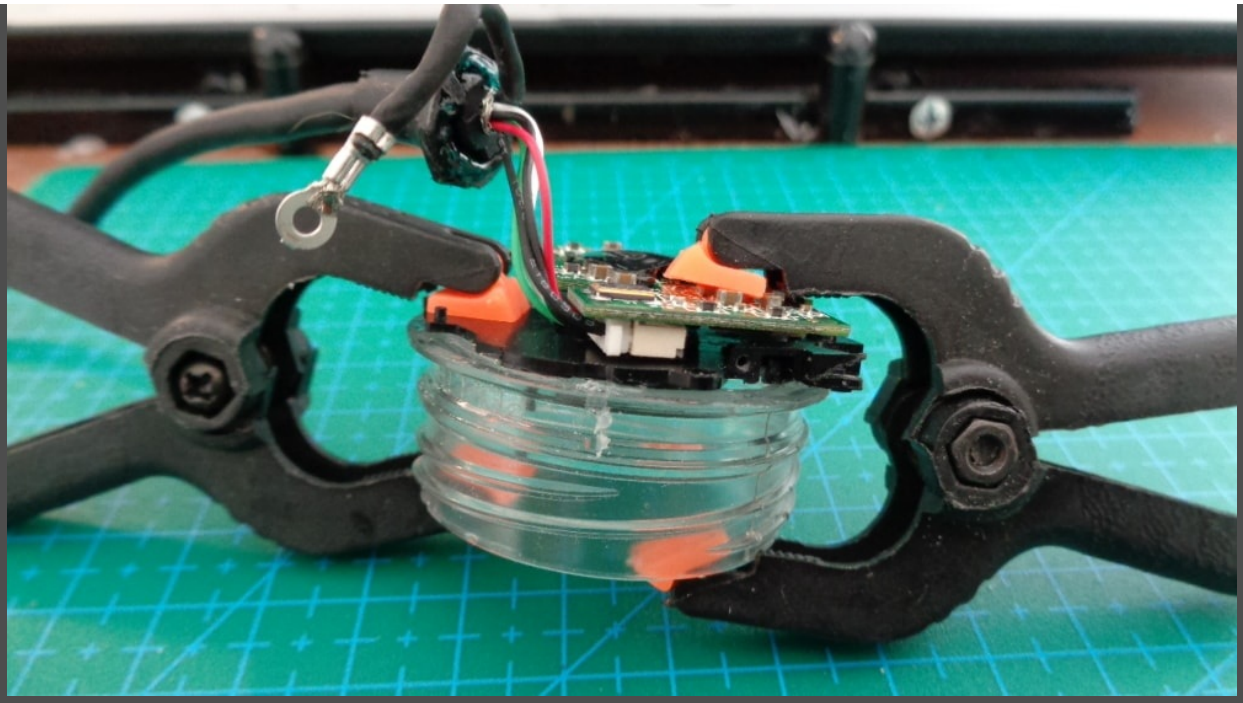
The best way to separate the ring from the body is to use a hacksaw (or a similar fine saw), sawing directly under the small plastic projection. To make this easier for me, I have clamped everything in a parallel vice. But it works quite well without it. You just have to be careful not to slip off with the saw, but you should always pay attention to that anyway.

Since I don't have a professional tool for questioning edges yet, I simply use a carpet knife. This is not quite so clean, but should be enough at the moment to be able to work with it reasonably.

On the two parts of our lens there are some superfluous pieces that we have to break off carefully. We'll use pliers for that. Everything that stands upright must be removed and prevent the plastic ring from being properly glued on.

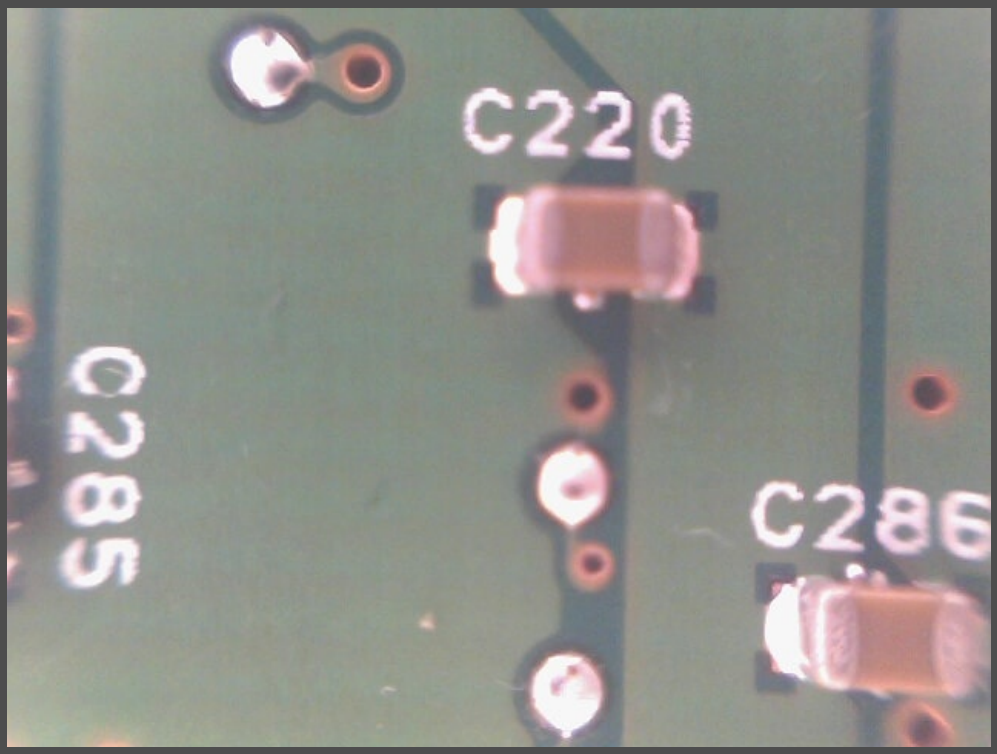


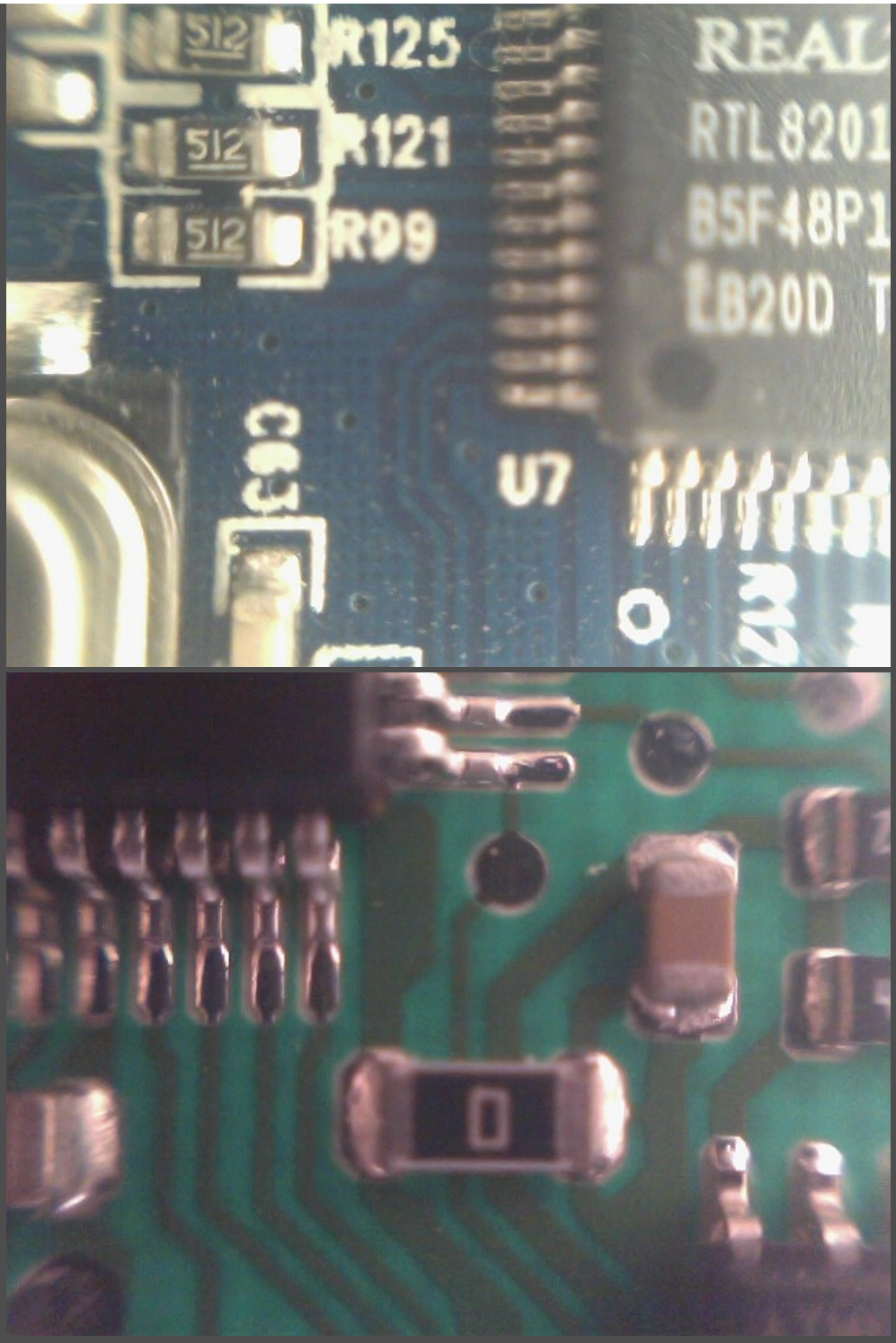
First I wanted to screw the ring to my construction (hence the small black dots). Unfortunately I noticed that although I have a very fine drill, I don't have a tensioner in the right size for my multifunctional device. Therefore I had to fix everything again with the impractical superglue.



USB Microscope final test

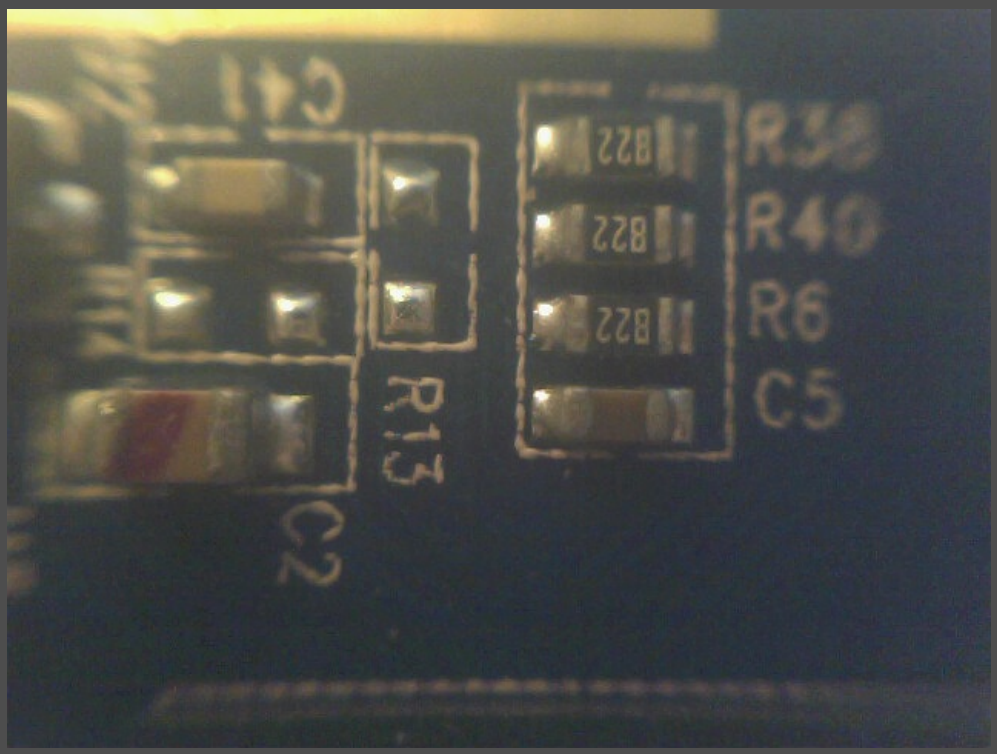
The final test brought the expected results. I could see a lot of small details on the examined boards and this will make my work a lot easier. This will help me in troubleshooting for broken solder joints or traces, for example, if I want to develop my own circuit board. The labels are also really easy to see.

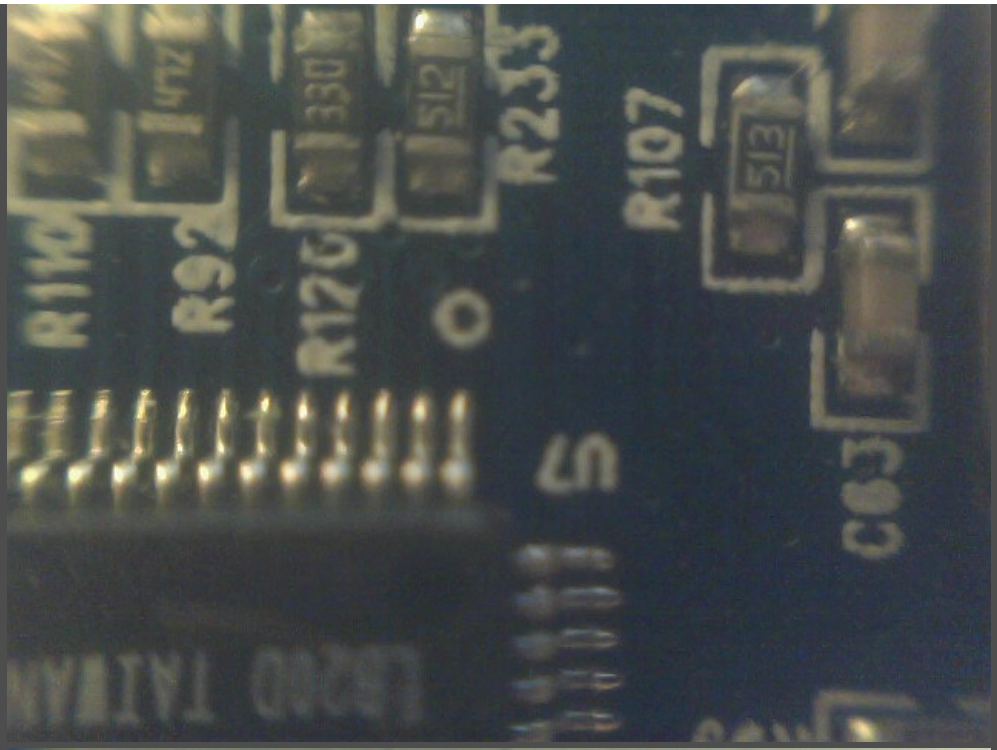




By chance I was able to catch a living fly and put it under the microscope. Since the ring has a certain height it could crawl further without being hurt. Unfortunately flies are really ungrateful models because they can crawl really fast and prefer to get out of the USB microscope instead of holding still for a moment to take a photo (or video). Since I am nevertheless sensitive to all living beings on this planet, I released them into freedom again after a few minutes. Unfortunately my roommate's cat was already waiting there (Arial) and yes…nature is merciless, the fly was eaten by her.

More Pictures

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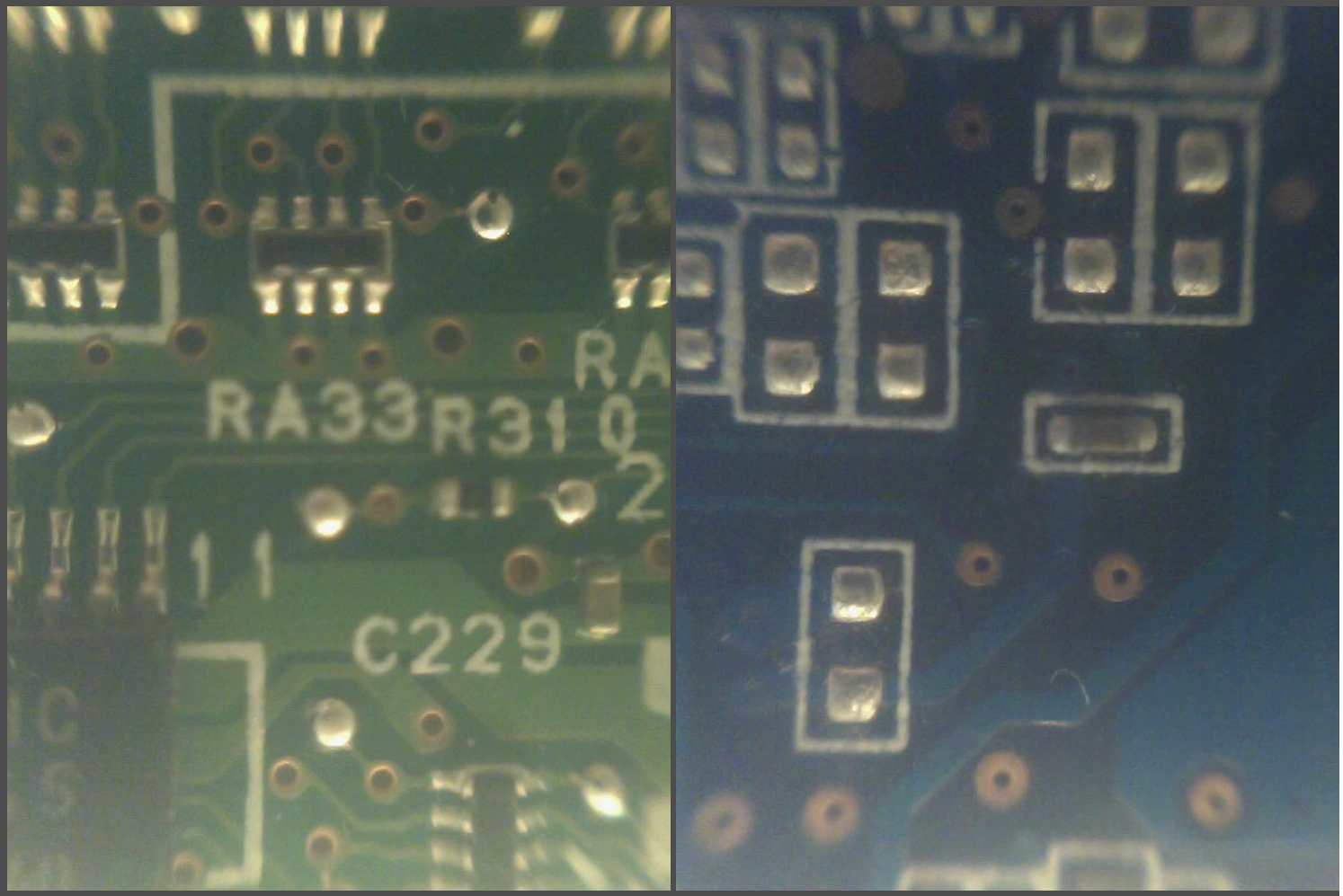
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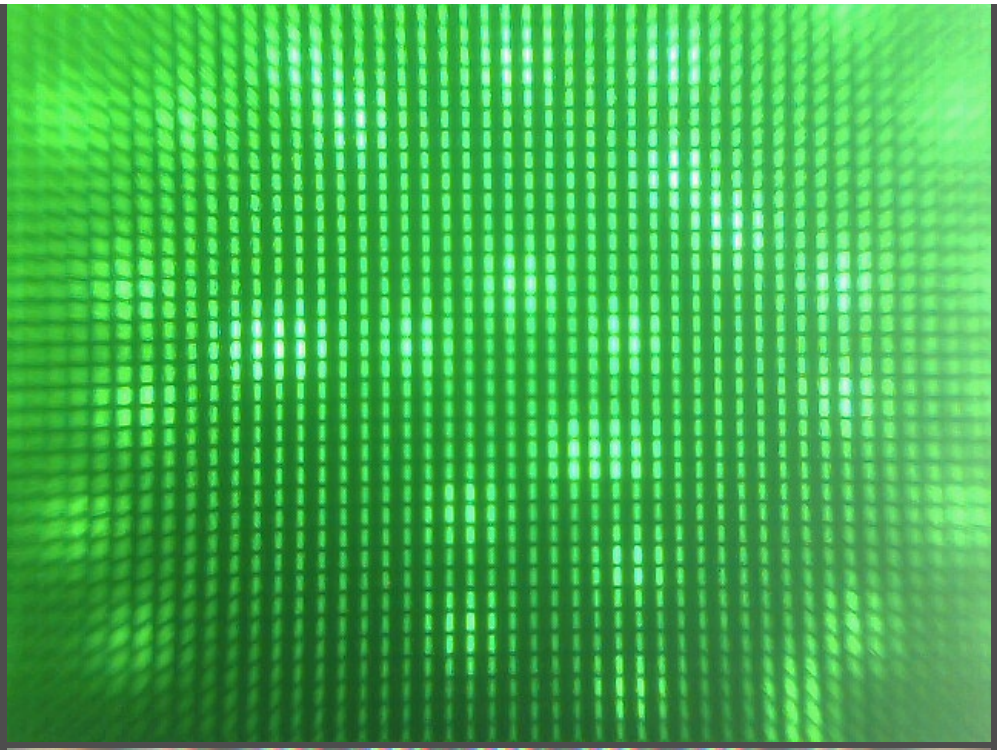

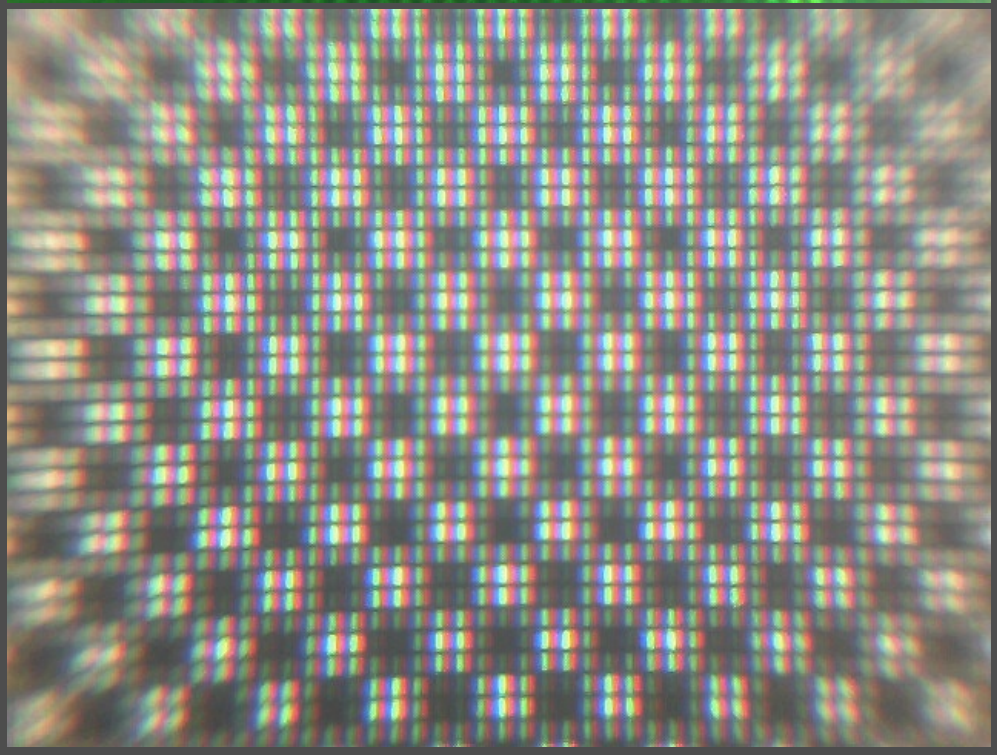

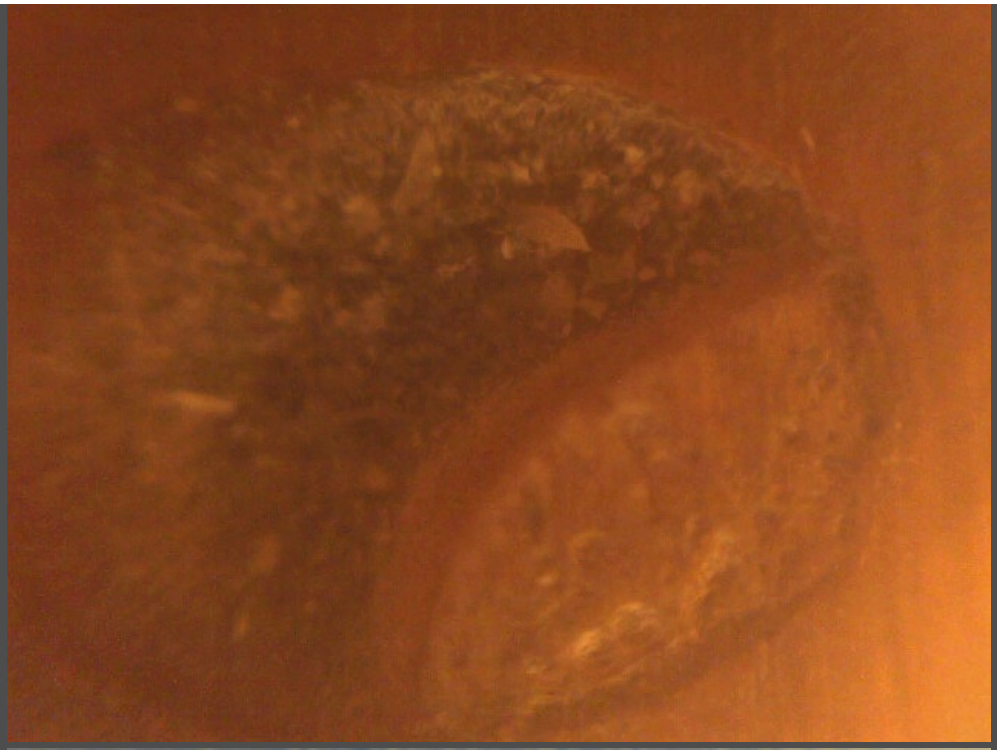

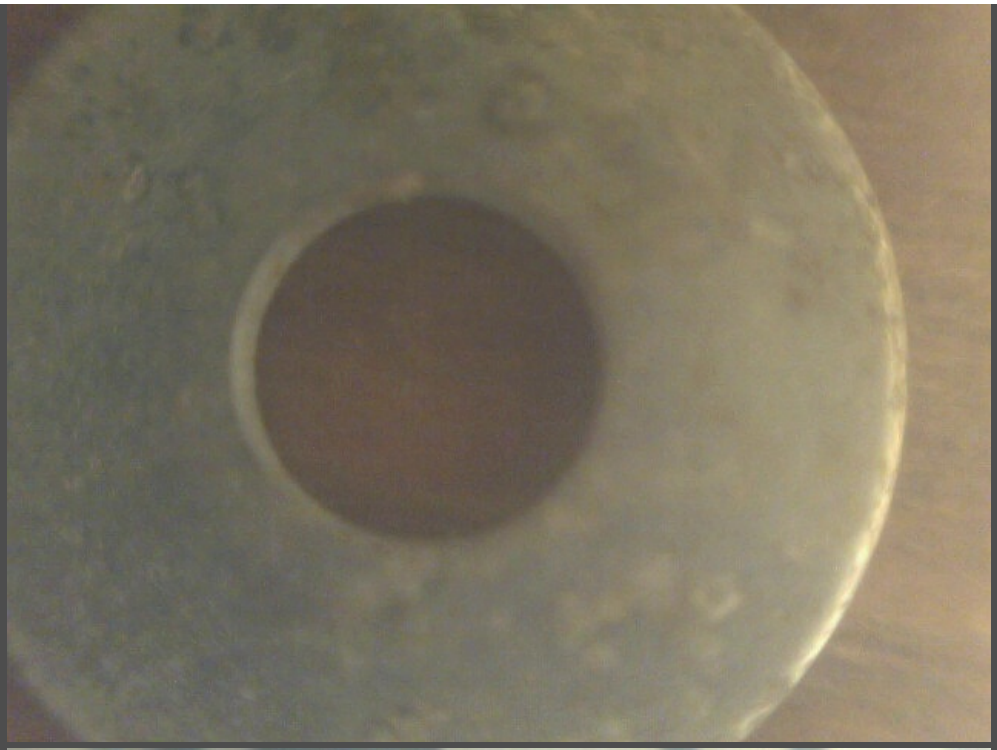

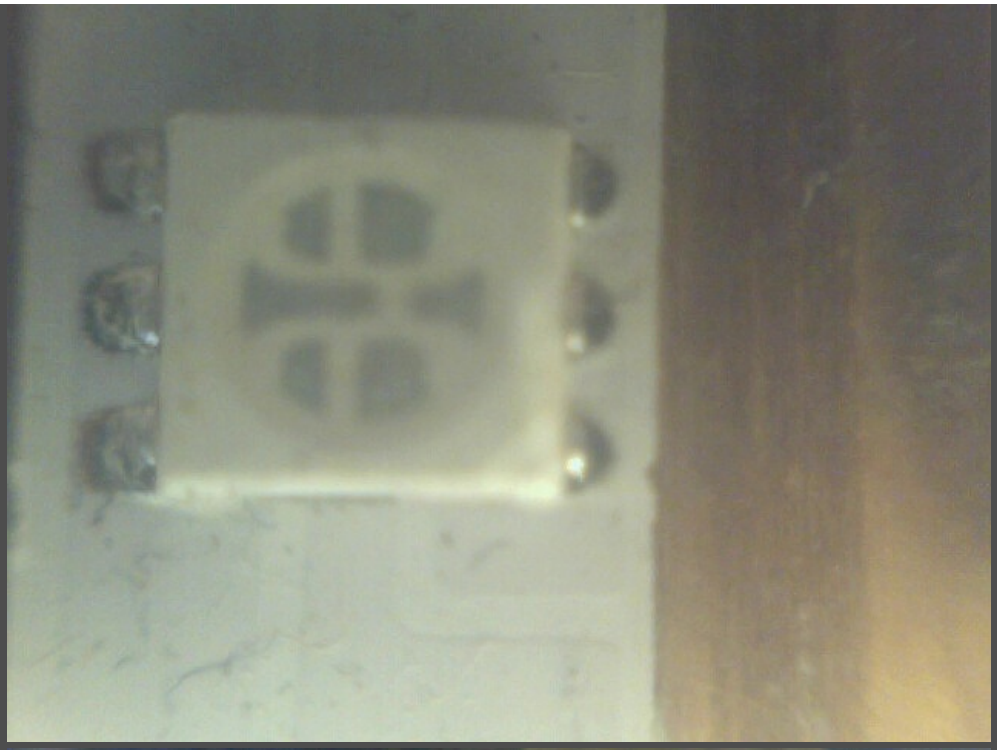

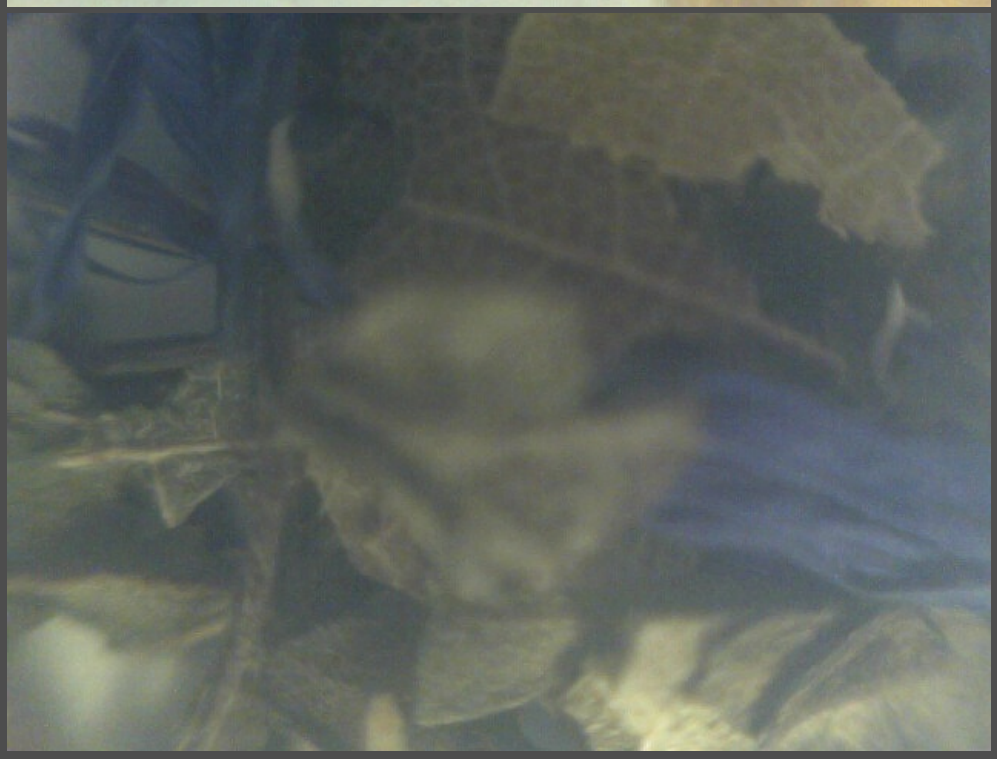

Conclusion

All in all, I was really surprised what you can get out with so little cheap technology. I've seen other tutorials, but either the quality was further below what I had achieved. If the quality was higher, much better lenses (e.g. from digital cameras) were used, but I can't afford them at the moment. I'm already thinking about how I can improve the USB microscope. But first I want to spend the next days in the forest or park to collect things that I can live under the microscope. I also have another idea that has to do with image recognition and machine learning.